THE

Accompliſh'd Sea-mans

DELIGHT,

CONTAINING,

1. The great Miſtery of Nature demonſtrated by Art, as the Flux and Reflux, Increaſe and Decreaſe, Acceſs and Receſs, Ebbing and Flowing of the Water of the Sea.

2. The Cloſſet of Magnetical Miracles unlocked, the properties and ſecrets of the *Loadſtone* revealed, ſerving not only for Sea Affairs, but alſo for Travellers by Land.

3. Directions for Sea-men in diſtreſs of Weather, alſo the right uſe of the Magnitical Needle, and how to Manage the Sayling Compaſs, and the reſt of the Inſtruments of Chiefeſt Uſe in the *Art* of *Navigation*.

4. The Reſolver of Curioſſities, being a profitable Diſcourſe of *Local*, as alſo of the ſwift Motion of the Art of *Navigation*. Of the due proportion to be obſerved in the Building of Ships, likewiſe rare Inventions of ſeveral Engons: With a perfect Diſcovery of other admirable *Mathematical Secrets*, and for their clearer Explaination, are Adorn'd with moſt ſignifican and propet Figures.

Firſt Read, then after that deſpiſe
Thy Prejudice, and be more wiſe.

LONDON, Printed for *Benj. Harris*, at the *Anchor* and *Mariner* in *Threedneedle Street*, over against the *Royal Exchange*, 1686.

Licensed,
October the 10th, 1685.
Rob. Midgley.

THE

Accompliſh'd Sea-mans DELIGHT, &c.

THough the *Pſalmiſt* tells us, that the Lord hath Founded the Earth upon the Seas, and Eſtabliſhed it on the Floods, *Pſal.* 24. 2. Becauſe for the more Commodious living of Man and Beaſts, he hath made a part of it higher then the Seas, or at leaſt reſtrained their Incurſion upon it, ſo as now they make but one intire Globe; yet becauſe the Waters in the firſt Creation covered the Face of the Earth, I will begin with them. The mother of Waters, the great deep, hath undoubtedly loſt nothing of her ancient bounds or depth, but what is impaired in one place, is again reſtored to her in another. The Rivers which the Earth ſucked from her by ſecret Veins, it renders back again with a full Mouth; and the Vapours which the Sun draws up, empty themſelves again into her Boſome, according to that Expreſſion of *Du, Bartas.*

The pureſt Humour in the Sea, the Sun
Exhales in the Aire: which there reſolved, anon
Returns to Water, and deſcends again,
By ſudry ways into his Mother main.

Her motion of Ebbing and Flowing, and of high Springs and dead Neapes, are ſtill as certain and conſtant as the Changes of the Moon and Courſes of the Sun; Her native ſaltneſs, and by reaſon thereof her

ſtrength, for the better ſupporting of *Navigable Veſſels* is ſtill the ſame, ſo likewiſe the Rivers, the Daughters thereof, either hold on their wonted Courſes and Currents, or what they have diminiſhed in one Age or place, they have again recompenced and repayed in another. Becauſe things move and are changed (without which ſuch and ſo great matters could not well be diſpoſed) we are to think the Earth doth not alwayes remain in the ſame ſtate, without addition or diminution; neither yet the Water, as if they were alwayes boudned within the ſame liſts, eſpecially ſeeing their mutual Change is natural and kindly, but rather that much Earth is turned into Water, and contrariwiſe no leſs Water into Earth; it is not then to be wondered at, if that part of the Earth which is now habitable was formerly overflowed with Water, and that again which now is Sea, was ſometimes habitable; as amongſt Fountains ſome are dryed up and ſome ſpring forth afreſh, which may alſo be variſyed of Rivers and Lakes, wherewith accords that of *Ovid*, *Met.* 15.

Vidi Ego quod fuerat quondam ſoli diſima tellus Eſſe Fretum.

What was firm Land ſometimes, that have I ſeen
Made Sea, and what was Sea made Land again;
On Mountain tops old Anchors found have been,
And Sea-fiſh ſhells to lie far from the main.
Plaines turn'd to Vales by Waterfalls, the Down
By overflows is chang'd to Champain Land;
Dry ground e're while, now mooriſh ſeen doth drown,
And Fens again are turn'd to thirſty Sand.
Her Fountains now hath Nature opened,
Their ſhut up ſprings which firſt did flow amain,
By Earth-quakes Rivers of ſin iſſued,
Or dryed up they have ſunk down again.

Nor

Nor in one place perpetually to tarry,
All things in every Age for ever more do vary,
And Nature changeth ſtill the courſe ſhe once begun,
And will her ſelf undoe what ſhe of Old hath done.

Which though it be true in many, yet thoſe great ones of *Indus* and *Ganges*, and *Danubius*, *Rhenes*, and *Nylus*, are little or nothing varied from the ſame courſes and currents which they held Thouſand of years ſince, as appears in their diſcriptions by the Ancient *Geographers*; but above all methinks the conſtant riſing of *Nylus* continued for ſo many Ages, is one of the greateſt wonders in the World, which is ſo preciſe in regard of time, that if you take of the Earth adjoyning of the River and preſerve it carefully, that it come neither to be wet nor waſted, and weigh it daily, you ſhall find it neither more nor leſs heavy till the ſeventeenth of *June*, at which day it beginneth to grow more ponderous, and Augmenteth with the Augmentation of the River, whereby they have an infalible Knowledge of the ſtate of the Deluge. This Mr. *George Sandys* reports, and *Alpinus* a Phyſitian names it as a common experiment. Whereas heretofore mention hath been made of the Sea and flowing of Waters, and divers other motions, it may be convenient to add hereunto the ſayings and writings of the moſt expert Learned Perſon *Frederick Delphinus*, Doctor of Arts and Phyſick, and publick profeſſor of the Mathematical Sciences in *Padua*, touching the flowing and reflowing, or increaſe or decreaſe (otherwiſe alſo named acceſs and receſs) that is, coming and going, or ebbing and flowing of the Water of the Sea. Which flowing and reflowing, ſome do alſo name, the falſe reſt or quietneſs, or inordinate motion of the Water of the Sea. And albeit divers men have Treated of this Subject, yet foraſmuch as ſome of their writings are ſomewhat too dark, and not eaſie of Men to be underſtood, I

have thought neceſſary, partly out of their Writings, and partly by my own Induſtry, more clearly and largly to Treat thereof, that the ſame may be the better underſtood of all men.

Therefore for the more eaſie underſtanding of theſe two manner of motions of the Water of the Sea, following the moving of the Sun and Moon, to the moving of the *Primum Mobile*. The firſt moveable, is firſt to be known, that whereſoever a man is on the Earth, his Horizon ever cutteth or divideth the Heaven to him into two hairs, and the one half of Heaven is ever above his Horizon, and the other half beneath, and whereas in the half of a Sperical or round Body, are contained two quarters, two ſhall ever be above his Horizon, and two beneath; thoſe that are above the Horizon, are called diurnall or day quarters: and they that are under the Horizon, are called the Nocturnal or Night quarters. Of theſe four quarters of Heaven, are two of which is made the flowing or increaſe of the Water of the Sea: and other two in which is made the flowing or increaſe of the Water of the Sea: and other two in which is made the flowing or decreaſe of the Sea. The quarters in the which is made the flowing, is the quarter which is from the *Eaſt* to the *South* above the Horizon, which is the quarter of the day acceſs, or increaſe of the day: and the quarter oppoſite or contrary, which is from the *Weſt* to midnight under the Horizon, which is the quarter of the night acceſs. The quarters in which is made the reflowing or decreſe, is the quarter which is from the *South* to the *Weſt* above the Horizon, which is the quarter of the receſs of the day: and the quarter oppoſite, which is from midnight to the *Eaſt* under the Horizon is the quarter of the receſs of the night.

Secondly, Is alſo to be known, that there are in Heaven eight points of the flowing and reflowing, or increaſe or decreaſe of the Sea: of the which, four are ſtrong

ſtrong, and four are weak, two are weak for the flowing, and two for the reflowing: weak for flowing, are the points of the *Eaſt* and *Weſt*; which are the beginning of the two quarters of flowing: weak for reflowing, is the point of the *South* or *Midday*, and the point of *Midnight*, which are the begining of the quarters of reflowing: and theſe four are diſtant the one from the other, by a quarter of Heaven. Of the ſtrong points, two are ſtrong for flowing, and two for reflowing. Strong for the flowing, is the middle point between the *Eaſt* and the *South*, being diſtant from the *Eaſt* 45 degrees, and from the *South* likewiſe, and the middle point between the *Weſt* and *Midnight*, in the night quarter of flowing, being diſtant from the *Weſt* 45 degrees, and from *Midnight* in the ſame manner. Points ſtrong for the reflowing, is the middle point between the *South* and *Weſt*, in the day quarter of the reflowing, being diſtant from the *South* 45 degrees, and from the *Weſt* likewiſe: And the *Middle* point, between *Midnight* and the *Eaſt*, in the quarter of the night reflowing, being diſtant from *Midnight* 45 degrees, and from the *Eaſt* likewiſe. And as the weak Points are diſtant one from the other by a quarter of the Heaven, ſo are alſo the ſtrong Points diſtant the one from the other by a quarter of Heaven, to them that have a right Horizon.

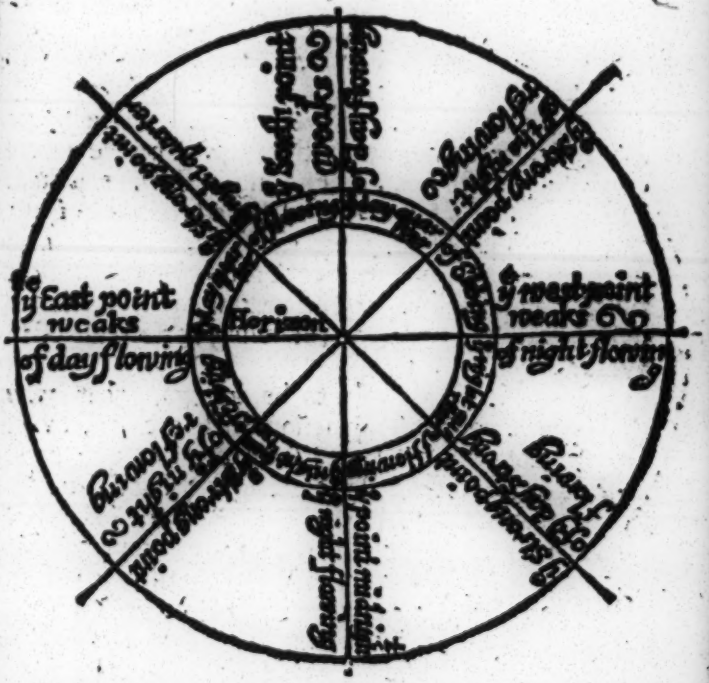
Thirdly, It is to be known, that beſides the aforeſaid eight Points, to ſuch as have a right Horizon, there are many other Points equipolent or of equal virtue. And ſuch are all the Points of Heaven, equally diſtant from the four principal Points of Heaven; which four principal Points are, the Point of the *Eaſt*, Point of the *Weſt*, Point of the *South*, and Point of *Midnight*, or from the four ſtrong Points of Heaven, which is all one, yet in quarters of contrary operation; for all ſuch Points are equipolent or of equal virtue in moving of the Water of the Sea: but in a right Horizon it is otherwiſe, as ſhall appear hereafter.

Fourthly, We are alſo to take notice, that the *Sun* and the *Moon* every month are together in one ſigne, degree, and minute. And this ſo being, is called the conjunction of the *Moon* with the *Sun*. From thence for the ſpace of eight days, or thereabout, the *Moon* is departed from the *Sun*, by her proper motion by a fourth part of Heaven: and this departing is called the firſt quarter of the *Moon* with the *Sun*. From thence about fourteen days, or near upon, ſhe is departed from the *Sun* another fourth part of Heaven, and ſo by the half of Heaven: and this diſtance is called the oppoſition of the *Moon* with the *Sun*, by the full *Moon*. From thence to 21 days, or thereabouts, ſhe is departed from her oppoſition with the *Sun* or *Full moon* by another fourth part of the Heaven, coming toward the *Sun*: and this diſtance is called the ſecond quadrature of the *Moon* with the *Sun*, and then the *Moon* is diſtant from the *Sun* by a fourth part of the Heaven, as it was diſtant the firſt quarter, and ſo cometh near to conjunction with the *Sun*. From thence at 30 days, or thereabouts, the *Moon* is again in conjunction with the *Sun* as ſhe was at the firſt.

Fifthly, and laſtly, We are to take notice that the *Sun* and the *moon*, both together every natural day (which is the time of 24 hours to the moving of the firſt moveable) are the cauſes of flowing and reflowing, or the increaſe or deceaſe of the Water of the Sea twice. The declarations premiſed, and well kept in memorie, Let us declare how the *ſun* and *moon* both together every natural day, to the moving of the firſt moveable, are the cauſes of the flowing and reflowing of the Sea. For if all theſe declarations are well kept in memory, and eſpecially the quarters of the Heaven in which is the flowing, and the quarters of Heaven in which is the reflowing, and which are the ſtrongeſt Points for the flowing, and ſtrong Points for the reflowing: Theſe (I ſay) being kept in memory, all the nar-

narration of the moving, and falſe quietneſs of the Sea ſhall be clear & manifeſt. For the further Illuſteration of what hath, or ſhall be ſaid hereafter, I have thought fit to inſert this following Figure.

A Figure ſhewing the beginning of the day increaſe at the Sun *riſing, and the beginning of the day decreaſe in the* Midday, *and the beginning of the* Night *increaſe at the* Sun *ſetting, and the beginning of the* Night *decreaſe at* Midnight.



THe Figure is ſo plainly demonſtrated, that we need not to make any ſtop for it, but to proceed.

First of all therefore (as touching the flowing and reflowing of the Sea, to the moving of the first moveable, it is to be known, that when the *Sun* and the *moon*, are joyned together, which conjunction is called *Novilunium* (that is) the new *moon*, when they are moved to the moving of the first moveable, from the *East* to the *South*, because the virtues both of the *Sun* and *moon* are united together, and both these Luminaries are moved continually in the moving of the first moveable by the quarters of the day flowing, which is from the *East* to the *West*; the day flowing or encrease of the Sea is continued: and while they move from the *South* to the *West*, because they are moved continually by the day quarter of the reflowing, the reflowing still continueth; and while they are moved from the *West* to *Midnight*, because they are then moved by the quarter of the night flowing. The night flowing is again continual, and while they are moved from *midnight* to the *East*, because they are then moved by the night quarter of reflowing, the night reflowing is again continual: and thus twice in the natural day is the flowing or encrease, and twice the reflowing or decrease of the Water of the Sea.

It is again secondarily to be known, that when the *moon* after her conjunction with the *Sun*, by her proper motion is departed from the *Sun* towards the *East*, according to the order of the signs, going towards the first quadrature of *Sun* (which the *Italian* Pilots call 41 quartirone) ever before the *moon* by her proper motion come to the first quarter, which is the distance of the *moon* from the *Sun* towards the *East*, according to the order of the signs, by a quarter or fourth part of the Heaven; when the *Sun* is so much above the Horizon of the *East* part in the quarter of the day flowing, how much the *moon* is under the Horizon in the same part of the *East* in the quarter of the night reflowing, because then the *Sun* is so much distant from the strong point of the

the flowing above the Horizon, they are equipollent and of equal virtue, therefore then is neither flowing nor reflowing of the Water of the Sea, but the Water ſeemeth to ſtand: which the *Venetians* call *L' aqua e' ſtanca*. But when the *ſun* by the motion of the firſt moveable, cometh near to the ſtrong Point of flowing, which is above the Horizon in the day quarter of flowing, the *moon* by the ſame motion of the firſt moveable, departeth ſo much from the *ſouth* Point of the reflowing, which is under the Horizon in the night quarter of the reflowing, coming towards the weak Point of the *Eaſt* flowing, then is the *moon* in the ſtrong point of reflowing, which is under the Horizon in the night quarter of the reflowing, the reflowing is weakned, and the flowing is fortifyed: And then the Water of the Sea begineth to flow. And how much more the *ſun* approacheth to the ſtrong point of flowing, which is above the Horizon in the day quarter of flowing, ſo much more the *moon* is departed rom the ſtrong Point of the reflowing, which is under the Horizon in the night quarter of the reflowing, approaching to the weak Point of the *Eaſt* flowing, and therefore the flowing continueth. But when the *ſun* by the motion of the firſt moveable, cometh to the ſtrong point of the flowing, which is above the Horizon in the day quarter of the flowing; then the *moon* is departed from the ſtrong Point of the reflowing, which is under the Horizon in the night quarter of reflowing, and is made near to the Point of the *Eaſt* flowing, and therefore the flowing yet continueth. But when the *moon* ſhall come to the weak Point of the *Eaſt* flowing, ſhe then to the moving of the firſt moveable, is moved by the day quarter of flowing, approaching to the ſtrong Point of flowing, which is above the Horizon: and the *Sun*, becauſe it is diſtant from the *moon* leſs then a quarter, ſhall likewiſe be moved by the ſame day quarter of the flowing, and approaching to the weak Point of the *ſouth* reflowing;

ing: and therefore becauſe both are moved by the day quarter of flowing, approaching to the ſtrong Point of flowing, which is about the Horizon: And the *ſun*, becauſe it is diſtant from the *moon* leſs then a quarter, ſhall likewiſe be moved by the ſame day quarter of flowing, approaching to the ſame weak Point of the *ſouth* reflowing: and therefore becauſe both are moved by the day quarter of the flowing, the flowing ſhall continue. And when the *ſun* by the moving of the firſt moveable, cometh to the weak Point of the reflowing, becauſe then the *moon* is nearer the ſtrong point of the flowing, which is above the Horizon, then the *ſun* to the ſtrong Point of the reflowing, which is above the Horizon in the day quarter of the reflowing, the flowing ſhall continue. And when that the *moon* ſhall come to the ſtrong point of flowing in the day quarter of flowing, the *ſun* ſhall not yet be in the ſtrong Point of the reflowing in the day quarter of the reflowing, becauſe the *ſun* is diſtant from the *moon* leſs then a quarter, but will come to it: and then the *moon* ſhall depart from the ſtrong point of the flowing, and ſhall be leſs diſtant from it then the *ſun* from the ſtrong Point of reflowing, and therefore the flowing ſhall yet continue, untill the *ſun* be ſo much beyond the *South* towards the *Weſt* in the day quarter of reflowing, how much the *moon* is on this ſide the *ſouth* towards the *Eaſt* in the day quarter of flowing: And then the *ſun* ſhall be ſo much diſtant from the ſtrong Point of flowing, which is above the Horizon, beyound the *South* in the day quarter of the reflowing; how much the *moon* is from the ſtrong Point of the flowing, which is above the Horizon, before the *South* in the day quarter of flowing: and incontinently the *ſun* and the *moon* ſhall be equipolent or of equal ſtrength, and therefore ſhall be no flowing nor reflowing as we have ſaid before.

And when the *ſun* by the motion of the firſt moveable ſhall come to the ſtrong Point of reflowing, in the

day

day quarter of reflowing, the *moon* by the ſame motion of the firſt moveable, ſhall be departed ſo much from the ſtrong Point of flowing in the day quarter of flowing, coming towards the weak Point of the *South* reflowing: and then the *moon* ſhall be more diſtant from the ſtrong Point of flowing, then the *ſun* from the ſtrong Point of reflowing. And ſo the *ſun* ſhall be ſtronger than the *moon*, and therefore then ſhall begin the reflowing, and ſhall continue according aa the *ſun* ſhall approach to the ſtrong point of the reflowing, in the day quarter of the reflowing: and the *moon* ſhall be departed from the ſtrong Point of the flowing, in the quarter of the day flowing. And when the *ſun* ſhall come to the ſtrong Point of the reflowing. the *moon* ſhall be departed frem the ſtrong Point of the flowing, in the quarter of the day flowing. And when the *ſun* ſhall come to the ſtrong Point of the reflowing, the *moon* ſhall be departed from the ſtrong Point of the flowing, and therefore the reflowing ſhall continue, And when the *moon* ſhall come to the weak Point of the *South* reflowing, the *ſun* ſhall be departed from the ſtrong Point of the reflowing, in the day quarter of the reflowing, coming towards the weak Point of the *Weſt* flowing: yet ſhall the *ſun* be leſs diſtant from the ſtrong Point of the reflowing, then the *moon* from the ſtrong Point of the flowing, and therefore the reflowing ſhall yet continue. And when the *ſun* ſhall come to the weak point of the *Weſt* flowing: yet ſhall the *ſun* be leſs diſtant from the ſtrong Point of the reflowing, then the *moon* from the ſtrong Point of the flowing, and therefore the reflowing ſhall yet continue. And when the *ſun* ſhall come to the weak Point of the *Weſt* flowing, the *moon* ſhall be near to the ſtrong Point of reflowing, which is above the Horizon, in the day quarter of reflowing, and ſhall be leſs diſtant from it, then the *ſun* from the ſtrong Point of the flowing, which is under the Horizon in the night quarter of

flowing

flowing, because she is distant from the Sun less then a quarter of the fourth part of Heaven: therefore the reflowing shall yet continue, until the Sun shall be so much on the Horizon on the *West* part in the quarter of the night flowing, how much the *Moon* is above the Horizon in the same part of the *West* in the day quarter of reflowing. And because then the *Moon* shall be so much distant from the strong Point of the flowing, which is under the Horizon in the *West* part, in the night quarter of the flowing, as the *Moon* from the strong Point of reflowing, which is above the Horizon in that part of the *West* in the day quarter of reflowing: then the *Sun* and the *Moon* shall be equipollent (that is) of equal strength and virtue, and so shall there be neither Flooowing nor Reflooowing.

But when the *Sun*, by the moving of the first moveable, shall come to the strong Point of the Flowing, which is under the Horizon in the night quarter of the Flowing; the *moon* by the same moving of the first moveable, shall be departed as much from the strong Point of reflowing, which is above the Horizon in the day quarter of Reflowing: and then the *Sun* shall be less distant from the strong Point of Reflowing, which is above the Horizon in the day quarter of Reflowing, & then the *Sun* shall be less distant from the strong point of flowing, in the night quarter of flowing, then the *moon* from the strong Point of reflowing, in the day quarter of reflowing, and therefore the *Sun* shall be stronger than the *moon*: and then again shall begin the flowing, and shall continue (as is said before) untill the *Sun* be so much beyond midnight towards the *East*, in the night quarter of reflowing, how much the *moon* is on this side midnight, towards the *West*, in the night quarter of flowing, and the *Sun* shall be so much distant from the strong Point of reflowing, as the *moon* from the strong Point of the flowing: and then incontinently the *Sun* and the *moon* shall be of equal strength,

and

and there ſhall be neither flowing nor reflowing.

But when the *Sun*, by the moving of the firſt moveable, cometh to the ſtrong pont of the reflowing, in the Night quarter of reflowing, the *Moon* by the ſame moving of the firſt moveable, goeth back and is departed as much from the ſtrong point of the Flowing, in the Night quarter of the Flowing, comming to the weak point of Midnight reflowing: and then the *Sun* ſhall be leſs diſtant from the ſtrong point of reflowing, in the Night quarter of the flowing, and then ſhall the flowing be weakned, and the reflowing ſtrengthned, and the water of the Sea ſhall then begin again, the reflowing ſhall continue (as is ſaid before) untill the *Sun* be ſo much above the Horizon on the *Eaſt* part, how much the *Moon* is under the Horizon on the ſame part of the *Eaſt*: and then the *Sun* ſhall be ſo much diſtant from the ſtrong point of the flowing, which is above the Horizon, in the day quarter of the flowing, how much the *Moon* is from the ſtrong point of the reflowing, which is under the Horizon, in the Night quarter of the reflowing: and then the *Sun* and the *Moon* ſhall be again of equal ſtrength, and there ſhall be neither flowing not reflowing.

Then dayly (that is to ſay, in every natural day) ſhall return the like change to this aforeſaid, untill the *Moon* by her proper motion, ſhall come to her firſt quadrature with the *Sun*, which the *Pilotes* and *Venetian* Marriners call it *quartirone*, (as I ſaid before) and when the *Moon* ſhall come to her firſt quadrature with the *Sun*, then when the *Sun* ſhall be in the weak Point of the Eaſt for the flowing, the *Moon* ſhall be in the weak Point of Midnight for reflowing: and then the *Sun* ſhall be ſo much diſtant from the ſtrong Point of the flowing, which is above the Horizon, on the Eaſt part, in the day quarter of the flowing, how much the *Moon* is from the ſtrong Point of reflowing, which is under the Horizon of the ſame part of the Eaſt, in the Night quarter

quarter of the reflowing: and ſo the *Sun* and the *Moon* again ſhall be of equal force and power, and there ſhall be but ſmall flowing, increaſe or diminiſhing. And when the *Sun* by the motion of the firſt moveable, ſhall come to the ſtrong Point of the flowing, which is above the Horizon, on the Eaſt part, in the day quarter of the flowing, the *Moon* by the ſame motion of the firſt moveable, ſhall come likewiſe ſo much to the ſtrong Point of the reflowing, which is under the Horizon on the ſame part of the Eaſt, in the Night quarter of the reflowing: and continually to the Diurnall or Day motion, the *Sun* ſhall be alſo much diſtant from the ſtrong Point of flowing, which is above the Horizon, in the day quarter of the flowing, how much the *Moon* is from the ſtrong Point of reflowing, and continently the *Sun* and *Moon* ſhall be again of equal power, untill the *Sun* by the moving of the firſt moveable, ſhall come to the ſtrong Point of flowing, which is above the Horizon; and then likewiſe the *Moon* ſhall come to the ſtrong Point of reflowing, which is under the Horizon, becauſe theſe Points are diſtant one from another by a quarter of Heaven, as the *Sun* and the *Moon* are diſtant from themſelves by a quarter of Heaven, and when the *Sun* by the motion of the firſt moveable, ſhall depart as much from the ſtrong point of the reflowing, which is under the Horizon, coming toward the weak point of the Eaſt flowing, and the *Sun* ſhall be continually diſtant ſo much from the ſtrong point of flowing, which is above the Horizon, how much the *Moon* is from the ſtrong point of reflowing, which is under the Horizon, untill the ſame come to the weak point of the South reflowing: and then the *Moon* likewiſe ſhall come to the weak point of the Eaſt flowing. And the *Sun* and the *Moon* ſhall be all this while of equal ſtrength, and incontinently there ſhall be neither flowing nor any notable reflowing, and ſhall be after the ſame manner while the *Sun* is in the motion of the firſt moveable,

be

e moved from the South to the West, because then the
Moon by the motion of the first moveable, shall be mo-
ed from the East to the South: and likewise while the
n shall be moved from the West, to Midnight, be-
use then the *Moon* shall be moved from the West to
Midnight. And so in all the time of one revolution of
Heaven, which is one day natural of 24 hours, the Sea
shall neither flow nor reflow sensibly, but shall seem to
stand, because the *Sun* and the *Moon* in all the time of
that revolution of Heaven, shall be ever of equal pow-
er, without any notable difference. And this chanceth
about the eight day after the conjunction of the *Moon*
with the *Sun*. And the false quietness of the Water of
the Sea, of which the *Venetians* use this manner of say-
ing, *Da gliotto a Jnove L' Aequa non si move.* From
the eight day to the tenth the Water moveth not.
When the *Moon* shall be departed from the *Sun*, beyond
the first quadrature, going towards her opposition with
the *Sun*, when the *Sun* shall be so much above the Ho-
rizon on the East part, in the day quarter of the flow-
ing, how much the *Moon* is under the Horizon in the
same part of the East, in the Night quarter of the re-
flowing, the *Sun* shall be so much distant from the
strong point of the flowing, which is above the Hori-
zon, in the day quarter of flowing, departing from it by
the motion of the first moveable, and coming to the
weak point of the reflowing, how much the *Moon* is
from the strong point of the reflowing, which is under
the Horizon, in the Night quarter of the reflowing,
coming to it by the same motion of the first moveable:
and then the *Sun* and the *Moon* shall be again of equal
power, and there shall be neither flowing nor reflow-
ing. And when the *Sun* by motion of the first move-
able, shall come to the weak point of the South reflow-
ing, the *Moon* by the same motion of the first moveable,
shall approach or come near as much to the strong point
of the reflowing, which is under the Horizon, in the
Night

Night quarter of the reflowing, then the *Moon* shall be nearer to the strong point of the reflowing, which is under the Horizon, in the Night quarter of the reflowing, then the *Sun* to the strong point of the flowing, which is above the Horizon, in the day quarter of flowing, because the *Moon* shall be stronger then the *Sun*: And according as the *Sun* by the motion of the first moveable shall approach to the weak point of the South reflowing, the *Moon* by the same motion of the first moveable, shall approach as much to the strong point of the reflowing, which is under the Horizon: and so the reflowing shall continue untill the *Sun* come to the weak point of the South reflowing. And when the Sun by the motion of the first moveable, shall depart from the weak point of the South reflowing, and shall be moved by the day quarter of the reflowing, approaching to the strong point of the reflowing, the *Moon* by the same motion of the first moveable, shall depart as much from the strong point of the reflowing, which is under the Horizon, in the Night quarter of the reflowing, and she shall be also moved by the quarter of the reflowing, as the *Sun* coming to the weak point of the East flowing, because the *Sun* and the *Moon* are distant between themselves more then by a quarter of Heaven: and so both shall be moved by the quarters of reflowing, and therefore the reflowing shall continue, untill the *Sun* shall be so much beyond the South, towards the West, in the day quarter of the reflowing, how much the *Moon* is on this side the South, towards the East, in the day quarter of flowing. And then the *Sun* shall be so much distant in the strong point of reflowing, in the day quarter of flowing, departing from it by the motion of the first moveable, towards the West, how much the *Moon* is from the strong point of flowing, which is above the Horizon in the day quarter of the flowing, coming to it: and so the *Sun* and the *Moon* shall be of equal force, and then shall be neither flowing nor reflowing.

And

And when the *Sun* by the motion of the first moveable, shall be departed from the strong point of the reflowing, which is above the Horizon, in the day quarter of the flowing, coming to the weak point of the West-flowing, the *Moon* by the same moving of the first moveable, shall approach as much to the strong point of flowing, which is above the Horizon in the day quarter of the flowing, then the *Sun* to the strong point of the reflowing, which is above the Horizon in the day quarter of flowing: and then the *Moon* shall be nearer to the strong point of flowing, then the *Sun* in the strong point of reflowing, in the day quarter of reflowing: and so the *Moon* shall be stronger then the *Sun*, and then shall begin the flowing. And as the *Sun* shall continually be departed from the strong point of reflowing, so the *Moon* continually shall approach the strong point of flowing, and the flowing shall continue. And when the *Sun* shall come to the weak point of the West flowing, the *Moon* shall yet move by the day quarter of the flowing, because the *Sun* and the *Moon* are distant one from the other more then by a quarter of the Heaven: and then the *Moon* shall be nearer the strong point of flowing, in the quarter of the day flowing, then the *Sun* in the strong point of flowing, in the quarter of the day flowing, then the *Sun* to the strong point of the flowing, which is under the *Horizon*, in the Night quarter of the flowing, and therefore the flowing shall continue. And when the *Moon* shall come to the weak point of the South reflowing, the *Sun* shall pass the weak point of the West flowing, approaching to the strong point of the flowing, which is under the *Horizon*, in the Night quarter of the flowing, and then the *Sun* shall be nearer the strong point of the flowing, which is under the *Horizon*, in the Night quarter of the flowing, then the *Moon* to the stronger point of the reflowing, which is above the *Horizon*, in the day quarter of the reflowing,

ing, and ſo the *Sun* ſhall be ſtronger then the *Moon* and therefore the flowing ſhall continue.

And when the *Sun* ſhall come to the ſtrong point of flowing, which is under the *Horizon*, in the Night quarter of the flowing, the *Moon* ſhall not yet be in the ſtrong point of reflowing, which is above the *Horizon*, in the day quarter of reflowing, becauſe the *Moon* is diſtant from the *Sun* more then by a quarter of the Heaven, and therefore the flowing ſhall yet continue, untill the *Sun* be ſo much under the *Horizon* on the Weſt part, in the Night quarter of the flowing, how much the *Moon* is above the *Horizon* on the ſame part of the Weſt, in the day quarter of the reflowing: and then the *Sun* ſhall be ſo much diſtant from the ſtrong point of the flowing, which is under the *Horizon* in the Night quarter of the flowing, coming to the weak point of the Midnight reflowing, how much the *Moon* is from the ſtrong point of reflowing, which is above the Horizon, in the day quarter of the reflowing coming to it: and therefore the *Sun* and the *Moon* ſhall be of equal ſtrength, and then ſhall be neither flowing nor reflowing.

Afterwards when the *Sun* by the motion of the firſt moveable, ſhall be diſtant from the point of the flowing, which is under the *Horizon* on the Weſt part, in the Night quarter of the flowing, coming towards the weak point of Midnight reflowing, the *Moon* by the ſame motion of the firſt moveable, ſhall approach much to the ſtrong point of reflowing, which is above the *Horizon*, in the day quarter of the reflowing coming to it. And ſo the *Moon* ſhall be nearer the ſtrong point of reflowing, then the *Sun* to the ſtrong point of flowing, and therefore the flowing ſhall begin, and ſhall continue in manner (as is ſaid) untill the *Sun* be ſo much beyond Midnight, towards the Eaſt, in the Midnight quarter of reflowing, how much the *Moon* before Midnight towards the Weſt, in the Night quarter

er of flowing: and the *Sun* ſhall be ſo much diſtant from the ſtrong point of reflowing, in the Night quarter of reflowing, going backward from it towards the foreſaid weak point of the Eaſt flowing, how much the *Moon* is from the point of the ſtrong flowing, in the Night quarter of the flowing coming to it: and then the *Sun* and the *Moon* ſhall be of equal force, and there ſhall be neither flowing nor reflowing.

And when the *Sun* by the motion of the firſt moveable, ſhall be departed from the ſtrong point of reflowing, under the *Horizon*, which is in the Night quarter of reflowing: then ſhall the flowing begin, and continue in like manner aforeſaid, untill the *Sun* be ſo much above the *Horizon* on the Eaſt part, in the day quarter of flowing, how much the *Moon* is under the *Horizon*, on the ſame part of the Eaſt, in the Night quarter of reflowing. And becauſe the *Sun* ſhall be ſo much diſtant from the ſtrong point of flowing, which is above the *Horizon* in the day quarter of flowing, coming by the motion of the firſt moveable, towards the weak point of the South reflowing, how much the *Moon* is from the ſtrong point of reflowing, which is under the *Horizon*, in the Night quarter of reflowing, coming by the ſame motion of the firſt moveable towards it, they ſhall be of equal force, and ſo ſhall be neither flowing nor reflowing. And in this manner, the flowing and reflowing ſhall continue in every natural day, untill the *Moon* ſhall come to her oppoſition with the *Sun*.

And when the *Moon* ſhall come to her oppoſition with the *Sun*, then the *Sun* ſhall be in the weak point of the Eaſt flowing, the *Moon* ſhall likewiſe be in the weak point of the Weſt flowing: and then ſhall the flowing begin, and ſhall continue as long as the *Sun* ſhall be moved to the moving of the firſt moveable, from the weak point of the Eaſt flowing, by the day quarter of the flowing, to the weak point of the South reflowing. And the *Moon* then in all this time, ſhall be moved likewiſe to the moving of the firſt moveable, from the

weak

weak point of the West flowing, by the Night quarter of flowing, to the weak point of the Midnight reflowing: and then the flowing shall cease, and the reflowing begin, and continue as long as the *Sun* is at the moving of the first moveable, and shall be moved from the weak point of the South reflowing, by the day quarter of reflowing, unto the weak point of the West flowing, and the *Moon* also in all this time shall be moved likewise to the moving of the first moveable, from the weak point of the Midnight reflowing, by the Night quarter of reflowing, unto the weak point of the East flowing: and then the reflowing shall cease, and the flowing shall begin again, and shall continue as long as the *Sun* shall be moved to the motion of the first moveable, from the weak point of the West flowing, by the Night quarter of the flowing, unto the weak point of Midnight reflowing. And then the *Moon* in all that time, by the same moving of the first moveable, shall likewise be moved form the weak point of the East flowing, by the day quarter of the flowing, unto the weak point of the reflowing: and then the flowing shall cease, and the reflowing begin, and shall continue as long as the *Sun*, by the moving of the first moveable, shall be moved from the weak point of Midnight reflowing, by the Night quarter of the reflowing, unto the weak point of the East flowing. And then the *Sun* in all this time, by the same motion of the first moveable, shall be moved likewise from the weak point of the South reflowing. And then the *Moon* in all this time by the same motion of the first moveable, shall be moved likewise from the weak point of the South reflowing, by the day quarter of the reflowing, unto the weak point of the West flowing, and then the reflowing shall cease.

And when the *Moon* shall pass her opposition with the *Sun* by her proper motion, goin to her second quadrature with the *Sun*, then when the *Moon* shall be

so much above the Horizon, on the East part, in the day quarter of flowing, how much the *Sun* is under the Horizon on the same part of the East, in the Night quarter of the reflowing, because then the *Moon* shall be so much distant from the strong point of flowing, which is above the Horizon in the day quarter of flowing, how much the *Sun* is from the strong point of reflowing, which is under the Horizon, in the same part of the East, in the Night quarter of reflowing, then the *Sun* and the *Moon* shall be of equal power, and there shall be neither flowing nor reflowing. And when the *Moon* by the motion of the first moveable, shall be departed from the strong point of flowing, which is about the Horizon, in the day quarter of flowing, coming towards the weak point of the South reflowing, the *Sun* by the same motion of the first moveable, shall approach as much to the strong point of reflowing, which is under the Horizon, in the East part in the Night quarter of reflowing, then the *Moon* from the strong point of flowing, which is above the Horizon, to the South part of the East in the day quarter of flowing, and the reflowing shall begin and continue. And when the Moon by the motion of the first moveable, shall come to the weak point of the South reflowing because the Sun and the Moon are distant from themselves more then by a quarter of the Heaven, and then the Moon to the moving of the Moon by the moving of the first moveable, shall be moved by the day quarter of reflowing, coming to the strong point of reflowing, in the day quarter of reflowing, and so the reflowing shall continue.

And when the Moon shall approach to the strong point of reflowing, in the day quarter of reflowing, the Sun shall approach to the weak point of the East flowing, in the Night quarter of reflowing, and shall be further distant from the strong point of flowing which is above the Horizon, in the day quarter of reflowing

flowing, then the Moon from the ſtrong point of the reflowing, which is likewiſe above the Horizon, in the day quarter of reflowing: and ſo the flowing ſhall continue, untill the Moon be ſo much beyond the South, towards the Weſt, in the day quarter of the reflowing, the Sun before the South, towards the Eaſt, in the day quarter of flowing, and then the Moon ſhall be ſo far diſtant from the ſtrong point of reflowing, in the day quarter of reflowing, how much the Sun from the ſtrong point of flowing, in the day quarter of flowing: And ſo the Sun and the Moon ſhall be of equal force, and there ſhall be neither flowing nor reflowing. And when the Moon by the motion of the firſt moveable, ſhall approach as much to the ſtrong point of flowing, in the day quarter of flowing; then becauſe the Sun ſhall be near to the ſtrong point of flowing, in the day quarter of flowing, then the Moon in the ſtrong point of reflowing, which is in the day quarter of reflowing, the flowing ſhall begin and continue according to the Moon; to the moving of the firſt moveable, ſhall be departed from the ſtrong point of reflowing, in the day quarter of reflowing, coming towards the weak point of the Weſt flowing: and the Sun ſhall alſo approach the ſtrong point of the reflowing, in the day quarter of the flowing coming to it.

And when the Moon to the moving of the firſt moveable, ſhall come to the weak point of the Weſt flowing, the Sun yet by the moving of the firſt moveable, ſhall move by the day quarter of the flowing, becauſe the Sun and the Moon are diſtant one from the other more then by a quarter of Heaven, and the Sun ſhall be more near to the ſtrong point of the flowing, in the day quarter of flowing, then the Moon to the ſtrong point of reflowing, in the day quarter of reflowing, and therefore the flowing ſhall continue.

And when the Sun ſhall come to the weak point of the South reflowing, the Moon ſhall be under the Horizon,

rizon, in the Weſt part, in the Night quarter of the flowing, which is under the Horizon in the Night quarter of the flowing, then the Sun to the ſtrong point of the reflowing, which is above the Horizon, in the day quarter of reflowing: and therefore the flowing ſhall yet continue, untill the Moon ſhall be ſo much under the Horizon, on the Weſt part, in the Night quarter of flowing, how much the Sun is above the Horizon, on the ſame part of the Weſt, in the day quarter of reflowing. And then the Moon ſhall be ſo much diſtant from the ſtrong point of flowing, under the Horizon, in the Night quarter of flowing, coming towards the weak point of the Midnight reflowing, how much the Sun from the ſtrong point of reflowing is above the Horizon, in the day quarter of reflowing coming to it: and ſo the Sun and the Moon ſhall be of equal ſtrength, and then ſhall be neither flowing nor reflowing.

And when the Moon by the motion of the firſt moveable, ſhall be departed from the ſtrong point of reflowing which is under the Horizon, on the eaſt part of the Night quarter of reflowing towards the weak point of the Eaſt flowing, the Sun by the ſame moveing of the firſt Moveable, ſhall approach as much to the ſtrong point of flowing, which is under the Horizon on the Weſt part in the Night quarter of flowing comming to it: and then becauſe the Moon ſhall be more diſtant from the ſtrong point of reflowing, then the Sun from the ſtrong point of flowing, then ſhall begin the flowing becauſe the Sun ſhall be ſtronger then the Moon. And how much more the Moon ſhall be diſtant from the ſtrong point of reflowing, in the Night quarter of reflowing, ſo much more the Sun ſhall approach the ſtrong point of flowing, in the Night quarter of flowing, and ſo the flowing ſhall continue. And when the Moon ſhall come to the weak point of the Eaſt flowing, the Sun ſhall yet be in the Night quarter of flowing, becauſe the Sun is diſtant from the Moon more then by

a quarter of the Heaven, and the Sun ſhall be nearer to the ſtrong point of flowing in the Night quarter of flowing, then the Moon to the ſtrong point of reflowing, whith is in the Night quarter of reflowing, and ſo the flowing ſhall continue untill the Moon be ſo much above the Horizon on the Eaſt part; And then the Moon ſhall be ſo much diſtant from the ſtrong point of flowing, which is above the Horizon in the day quarter of flowing, departing from it by the motion of the firſt Moveable towards the weak point of the South reflowing, how much the Sun from the ſtrong point of reflowing, which is under the Horizon in the Night quarter of reflowing, comming to it by the ſame motion of the firſt Moveable. And then the Sun and the Moon ſhall be of equal force, and there ſhall be neither flowing nor reflowing, and the firſt diſpoſition ſhall return again, and ſuch flowing and reflowing, ſhall continue every natural day in this manner, untill the Moon ſhall come to her Quadrature with the Sun.

And when the Moon ſhall be in the ſecond Quadrature, then the water of the Sea, ſhall neither flow nor reflow, but ſhall ſeem to be at reſt, as it was in the firſt Quadrature, in the which, in the whole revolution of Heaven, the Sun and the Moon were ever of equal ſtrength for the cauſes declared: for the ſame are the canſes of the ſecond Quadrature, which are alſo of the firſt, and is above 21 Dayes. And this quietneſs or ſtay of the water of the Sea (as is ſaid before) the *Venetians* call it, *Acqua de fele*, and uſe this ſaying: *Da Vent' uno a' Venti' de, L' acqua non vane ſu, ne giu*, from the 21. to 22, the waters goeing neither up nor down.

And when the Moon by her proper motion ſhall paſs this ſecond Quadrature, proceeding to her conjunction with the Sun, then the Moon ſhall be diſtant from the Sun, leſs then the fourth part of Heaven, then when ſhe ſhall be diſtant from the Sun, leſs then fourth part of the

he fourth part of Heaven. And then when ſhe ſhall e ſo much above the Horizon the Eaſt part, in the day quarter flowing, as the Sun under the Horizon on the ame part of the Eaſt, in the Night quarter of reflowing, then the Moon ſhall be ſo much diſtant from the trong point of flowing which is above the Horizon, in he Day quarter of flowing, comming to it by the firſt motion of the firſt moveable, how much the Sun from the ſtronger point of flowing, which is under the Horizon in the Night quarter of reflowing, going from it by the ſame motion of the firſt moveable toward the weak point of the Eaſt flowing: And then the Sun nd the Moon ſhall be of equal power, and there ſhall e neither flowing nor reflowing. And when the Moon y motion of the firſt Moveable, ſhall come to the trong point of flowing, which is above the Horizon n the Day quarter of flowing, the Sun by the ſame motion of the firſt Moveable, ſhall depart as much from the ſtrong point of reflowing, which is under he Horizon in the Night quarter of reflowing, toward the weak point of the Eaſt flowing. And then becauſe the Moon ſhall be leſs diſtant from the ſtrong point of flowing, which is above the Horizon, in the Day quarter of flowing, then the Sun from the ſtrong point of reflowing, the Moon ſhall be ſtronger then the Sun, and therefore then ſhall begin the flowing: and how much more the Moon ſhall approach to the ſtrong point of flowing, ſo much more the Sun ſhall e diſtant from the ſtrong point of reflowing, approaching to the weak point of the Eaſt flowing, becauſe the Moon ſhall yet be in the Day quarter of flowing, for that ſhe is diſtant from the Sun leſs then a fourth part of Heaven, ſhe ſhall be leſs diſtant from the ſtrong point of flowing, which is above the Horizon, in the Day quarter of flowing then the Sun from the ſtrong point of reflowing, which is under the Horizon in the Night quarter

of reflowing, therefore the flowing shall yet continue.

And when the Moon shall come to the weak point of the South reflowing, the Sun shall be above the Horizon in the Day quarter of flowing, and shall be nearer the ſtrong point of flowing, then the moon to the ſtrong point of reflowing, which is above the mid-day (or the South) in the Day quarter of reflowing, becauſe the Sun is diſtant from the Moon leſs then the fourth part of Heaven, and therefore the flowing ſhall continue the Moon be ſo much beyond the South towards the weſt, in the Day quarter of reflowing, how much the Sun is before the South towards the Eaſt, in the Day quarter of flowing: and then the Moon ſhall be ſo much diſtant from the ſtrong point of reflowing, in the Day quarter of reflowing coming to it by the motion of the firſt Moveable: and ſo the Sun and the Moon ſhall be of Equal force, and there ſhall be neither flowing nor reflowing. And when the Moon ſhall by the Motion of the firſt moveable, aproach to the ſtrong point of reflowing in the Day quarter of reflowing, the Sun by the ſame motion of the firſt Moveable, ſhall go back and depart as much from the ſtrong point of flowing, in the Day quarter of flowing; and then the Moon ſhall be nearer to the ſtrong point of reflowing, in the Day quarter of reflowing, and ſo the Moon ſhall be ſtronger then the Sun, and therefore ſhall begin the reflowing, and the flowing and reflowing ſhall continue in the ſame manner as is ſaid.

When the Moon departeth from her Conjunction with the Sun, and is not come to her firſt Quadrature with the Sun, as is between the Conjunction and the firſt Quadrature, and when the Moon ſhall come to her Conjunction with the Sun, then again all the diſpoſition before declared, ſhall return in all points in like manner as is ſaid, Therefore this motion of

the

the water of the Sea, whereof we have spoken, is a motion following the motion of the Sun and Moon to the motion of the first moveable, for if you shall well consider that we have said of the flowing and reflowing (that is) increase and decrease, or access and recess of the water of the Sea, you shall understand that the beginnings of such flowings and reflowings, and likewise the rest and quietness, chance diversly in the hours of the Day and of the Night: for they come not alwayes in the same houres of the day as is manifestly known to such as observe such flowings and reflowings, or else false rest and quietness of the Water of the Sea. And therefore by what is written doth appear that the Water of the Sea hath motion of flowing, once in the Day and once in the Night: and likewise of reflowing once in the Day and once in the Night.

It is manifest also that the flowing doth not allwayes begin at the same hour of the Day or Night, but at divers hours: and likewise of the reflowing.

Also the time of flowing or reflowing, proceedeth inordinatly when the Moon is in her Quadratures with the Sun, that is, in the first or second.

There chanceth sometimes great increase of Waters, sometimes less, that is, when the Moon shall be in any other place from the Sun besides these four that is in the Conjunction, or Opposition, or her first Quadrature or second with the Sun.

And as are sometimes increases of Waters, greater or lesser, even so are the decreases in the like manner, the greatest concourses and Motions of Waters are when the Moon is in Conjunction with the Sun, and also the greatest flowings and reflowings. Likewise in Opposition of the Moon with the Sun, and the greater then in the time of the Conjunction of the Moon with the Sun. For the superiour bodyes, by their motion and light, give their influence to these inferiour bo-

dyes. And ſo much more as they have of Light, ſo much more and ſtronger they work: and becauſe in oppoſition of the Moon with the Sun, the moon is full of Light, and her Light is toward us, therefore it is reaſonable that then ſhould be cauſed greater flowings and reflowings, then in her Conjunction with the Sun. Nevertheleſs, becauſe that in her Conjunction with the Sun and Moon are both unite together, and their virtues, therefore alſo are great decreaſings and increaſings of waters, becauſe both their Virtues are unite, as I have ſaid, but yet greater is the Oppoſition then in the Conjunction, for cauſes before rehearſed.

The Moon being in her Quadrature with the Sun, the Water of the Sea hath no determinate time of flowing or reflowing, and then are the leſs concourſes of Waters, and leaſt flowing and reflowing. Such motion of the Sea the *Venetians*, as we have ſaid, call it *de fele*: and then the Water of the Sea hath no determinate beginning of flowing or reflowing, but is moved inordinately in a diverſe manner, ſometimes coming, and ſometimes going, the cauſe of this diverſity is, becauſe the Sun and the Moon, whereſoever they ſhall be in moveing to the water equally, or as it were unequally, have contrariety in whatſoever point they ſhall be: For in whatſoever point the Sun ſhall be, the Moon ſhall be in the point of oppoſite Virtue, contrary to the place of the Sun, or near.

And when the Moon ſhall be without the ſaid four places, then the Water of the Sea ſhall begin to come or go. And when the Sun and the Moon ſhall be in equall points of Virtue of the quarters of contrary operation, the concourſes of Waters ſhall be ſo much the greater, in how much the Moon ſhall be nearer to her Conjunction with the Sun, or to the Oppoſition: and ſo much the leſs in how much the moon ſhall be nearer to her quadratures, likewiſe the flowings

and

and the reflowings shall be ſo much the greater, for if the Moon ſhall be between the Conjunction with the Sun and the firſt Quadrature, then the Moon to the moving of the firſt moveable doth follow the Sun in his riſing, and then ſhall be the beginning of the day flowing, of the day after the riſing of the Sun, about three of the Clock, or before, that is, when the Moon ſhall be ſo much above the Horizon on the part of the Eaſt, in the day quarter of flowing, how much the Moon is under the Horiſon on the ſame part of the Eaſt, in the Night quarter of reflowing becauſe then the Sun and Moon ſhall be of equal force, becauſe they ſhall be in the points of equal Virtue in the quarters of contrary operation, and the beginning of the Night flowing ſhall be in the Night, after the ſetting of the Sun (that is) when the Sun ſhall be ſo much under the Horizon, on the ſame part of the Weſt, in the Day quarter of flowing, how much the Moon is under the Horizon on the ſame part of the Weſt, in the Day quarter of reflowing: and the beginning of the day reflowing ſhall be in the Day after noon when the Sun ſhall be ſo much after noon and the Day quarter of reflowing, how much the Moon before Noon, in the day quarter of flowing: and the beginning of the reflowing of the Night, ſhall be in the Day after Midnight (that is) when the Sun ſhall be ſo much after the point of Midnight, in the Night quarter of reflowing, how much the Moon ſhall be in the Night quarter of flowing. And if the Moon be in the firſt Quadrature and the oppoſition, the Moon yet in her riſing followeth the Sun, and then ſhall be the beginning of the Day following, in the day after Noon, about evening (that is) a little before or after, that when the Sun ſhall be ſo much above the Horizon on the part of the Weſt, in the Day quarter of reflowing, how much the Moon is above the Horizon on the part of the Eaſt, in the

Day quarter of flowing, and the beginning of the Night flowing, shall be on the Day before Day (that is) about Morning, before or after (that is) when the Sun shall be so much under the Horizon on the part of the East, in the Night quarter of reflowing; how much the Moon is under the Horizon on the part of the West, in the Night quarter of flowing: and the beginning of the Day reflowing, shall be in the Day before Noon, when the Sun shall be so much before the point of Noon, how much the Moon after the point of Midnight, in the quarter of the Night-flowing, how much the Moon is after the point of Noon, or Mid day, in the day quarter of reflowing. And if the Moon shall be between the oppsition of the Sun, and her second quadrature with the Sun, then the Moon in her rising goeth before the Sun, and then the beginnings both of flowings and reflowings, are in like manner as they were when the Moon was betwen the Conjunction and the first quadrature. For the beginning of the day flowing shall be in the day quarter about three of the Clock, before or after (that is to say) when the Sun shall be so much above the Horizon on the East part in the day quarter of flowing. And the beginning of the night flowing shall be in the Night, when the Sun shall be so much under the Horizon on the part of the West, in the Night quarter of reflowing, how much the Moon is under the Horizon on the part of the East, in the night quarter of reflowing: But the beginning of the day reflowing, shall be in the day, afternoon, when the Sun shall be so much after the point of the South, in the day quarter of reflowing, as the Moon before the point of Midnight, in the Night quarter of flowing. And the beginning of the Night reflowing, shall be in the day, when the Sun shall be so much after the point of Midnight, in the Night quarter of reflowing, how much the Moon is before the point of Noon, in the day quarter of flowing.

And

And if the Moon ſhall be between the ſecond quadrature, and her conjunction with the Sun, then the Moon alſo in her riſing ſhall go before the Sun: and then ſhall be the beginning of flowing and reflowing, in the ſame hours, as they be when the Moon is in the firſt quadrature and oppoſition: becauſe the beginning of the day of the day flowing, in the day after noon about evening, before or after, when the Sun ſhall be ſo much above the Horizon on the part of the Weſt, in the day quarter of reflowing, how much the Moon is under the Horizon on the ſame part of the Weſt, in the night quarter of flowing: and the beginning of the night flowing ſhall be in the night, about morning, before or after, when the Sun ſhall be ſo much under the Horizon on the part of the Eaſt, in the night quarter of reflowing, how much the Moon is above the Horizon in the ſame part of the Eaſt, in the day quarter of flowing. But the beginning of the day flowing, ſhall be on the day before noon, when the Moon ſhall be ſo much after the point of midday, or the South, in the day quarter of reflowing, how much the Sun is before it in the day quarter of flowing, and the beginning of the night reflowing, ſhall be in the night before midnight: that is, when the Moon ſhall be ſo much after the point of midnight, in the night quarter of reflowing, how much the Sun before the point of midnight, is in the night quarter of flowing. And hereby it appeareth, that as well the flowing as the reflowing of the Water of the Sea, begin (as we have ſaid) not always in the ſame hours of the night, for the beginning of flowing is either in the beginning of the day, or the beginning of the night, which chanceth, the Moon being in conjunction or oppoſition to the Sun, or is before day, from the morning towards the day, or from the day, untill four of the Clock, or thereabouts; or is before evening, towards the evening Tyde, and from thence to the Cock Crowing, or thereabouts: which chanceth

when the Moon is between her conjunction or oppoſition with the Sun, or any of the quadratures. The begining of the reflowing is either at noon, or at midnight, as when the Moon is in conjunction or oppoſition with the Sun, or is before noon, or after, or before midnight, or after, as when the Moon is between her conjunction or oppoſition with the Sun, and any of her quadratures. It is apparent alſo, that ſometimes the Water of the Sea doth not determinate or certain begining, neither order of flowing or reflowing, which chanceth, the Moon being in her quadratures with the Sun. It is manifeſt alſo, that all flowing of the Water of the Sea, is cauſed by reſpect to the Horizon, on the part of the Eaſt or Weſt. And every reflowing by the reſpect to the meridian, or to the point of midday, or midnight. Here alſo is to be conſidered, that all that is ſaid, are moſt certainly true in a right Horizon, but in an oblique or ſide Horizon, they ſometimes faile, as ſhall be ſaid hereafter following.

It happeneth (as I have ſaid) that the Water of the Sea doth ſometimes wander or decline from the order already preſcribed, yet commonly, and for the moſt part keepeth the due order. Such manner of declining is after two ſorts, for there is either diſorder or error in the hour of the begining of the motion of the flowing or reflowing, or in the middeſt of the motion: (that is) that they have greater or leſſer courſes then at other times, or otherwiſe greater or leſſer increaſes or decreaſes: the errour coming in the hour of motion, may proceed from the cauſes; as by reaſon of the ſituation of the Region, or by reaſon of the Bodies ſuperceleſtial, or by change of the Air.

By reaſon of ſituation of Regions, chanceth diverſity only in the hour of the begining of the flowing, becauſe the begining thereof hath reſpect to the Horizon, or is by reſpect to the Horizon: for in the begining of reflowing is no diverſity or errour, becauſe the begining of

of the reflowing, is by reſpect to the Meridian Circle. Again, by reaſon of the ſituation of the Region, diverſity happeneth thus, that is, that either the Region is under the Equinoctial Circle, or without it. And if it be under the Circle, becauſe they have a right Horizon, and the days there are always equal with nights, at all times of the year.

That we have ſaid of divers hours of the begining of flowing is certainly true: But Regions diſtant from the Equinoctial, becauſe they have a winding or ſlope Horizon, in them the beginings of flowings are, as in Regions under the Equinoctial, only in two times of the year: that is to ſay, in the Spring time, or Equinoctial Vernal, and in the time of *Autumne*, or Equinoctial *Autumnal*, that is to ſay, about the middeſt of the Month of *March*, and about the middeſt of the Month of *September*: But in other times of the year, or from the *Vernal* Equinoctial, by the whole Summer, until the Equinoctial *Autumnal*, it is otherwiſe, becauſe the begining of the day flowing, if the flowing be before noon, that is, about the morning, or ſhall be later then it ought to be: that is to ſay, more of the day then is in Regions under the Equinoctial, and that is, becauſe that in ſuch Regions the day begineth ſooner, or the Sun riſeth ſooner, then in the Regions which are under the Equinoctial: for the declining of the oblique or ſide Horizon (although theſe Regions be under one and the ſame Meridian) and if the begining of the day flowing be after noon, that is about evening, then ſuch begining ſhall be ſooner then it is in Regions under the Equinoctial (that is to ſay) in fewer hours of the day, becauſe that then the Sun ſaleth later then in Regions which be under the Equinoctial; but the begining of the night flowing, if it be before midnight, it is ſooner in the ſaid places or Regions (that is to ſay) in leſs time of the Night, or in leſs time after the ſetting of the Sun, then in the Regions under the Equinoctial: becauſe

cauſe that then the night begineth to them afterwards. And if the begining of the night flowing be after midnight (that is) towards the day, it ſhall be later (that is) of more hours, or more near the day, then is in Regions under the Equinoctial, becauſe the Sun riſeth ſooner to them, then to thoſe that are under the Equinoctial. And this diverſity groweth ſo much, that ſometimes it chanceth to ſee two flowings in one day, and none in the night: which happeneth from the inequality of the days, with their nights. For in how much the Artificial day ſhall be longer then his night, ſo much diverſity and errour ariſeth more evidently. Therefore in the longeſt days of the year, ſuch diverſity ſhall appear manifeſtly. But from the Equinoctial *Autumnal*, by all Winter, untill the Equinoctial *Vernal*, it is contrary: becauſe the begining of the day flowing, if it be before noon (that is) about the morning, then ſhall it be ſooner then it ſhould be (that is to ſay) in fewer hours of the day, then it ſhould be in a right Horizon: for then the day begineth later, or the Sun riſeth later to them that have a winding or crooked Horizon. And if ſuch flowing ſhall be after noon (that is) about evening, then the begining of ſuch flowing ſhall be latelyer (that is) more towards the evening, or nearer to the ſetting of the Sun, then in Regions which are under the Horizon; for in a ſide or crooked Horizon the night is ſooner, and the Sun falleth ſooner then in a right Horizon. Alſo, the begining of the night flowing, if it ſhall be before midnight, it ſhall be later and more in the night, then in Regions under the Equinoctial; becauſe then the night ſhall ſooner begin in the crooked Horizon then in the right, becauſe the Sun firſt falleth in the crooked Horizon, then in the right. And if the begining of the night flowing ſhall be after midnight, that is, towards the day, then ſuch begining of flowing in the crooked Horizon ſhall be ſooner, (that is) more before the day, or before the riſing

riſing of the Sun, then ſhall be in Regions which are under the Equinoctial. And ſuch diverſity groweth ſo much, that ſometimes ſhall be two flowings in the night, and none in the day. And this chanceth from the inequality and increaſe of the night above his day, for in how much the night ſhall be longer then his day, ſo much the more groweth ſuch diverſity, and therefore ſuch diverſity ſhall appear greateſt in the longeſt night of the year; wherefore by the aforeſaid, it is manifeſt, that how much the nearer we ſhall be to the Equinoctial, ſo much the leſs ſhall appear the diverſity in the hour of the begining of the flowing of the Water. And how much the Sun ſhall be nearer to the ſtandings or ſtayings of the Sun (called *Solititium*) or the longeſt days, and longeſt nights, ſo much greater and more certain ſhall be the diverſity, and ſhall appear more manifeſtly. Furthermore, diverſity happeneth by reaſon of the Heavenly Bodies, and Errour, not only in the begining of flowing, but alſo of reflowing.

For when any of the great and Luminous Stars (as are *Venus* and *Jupiter*) ſhall be above the Sun or Moon, they help them in moving of the Water of the Sea: and therefore by this means alſo, they leave their due order. Likewiſe (as we have ſaid) by reaſon of the change of the Air, oftentimes chanceth diverſity and errour in the beginings of flowing and reflowing: for the violent diſpoſition of Winds vehemently blowing, as well near as far off, removeth the Courſes of Water from their due order, ſomtimes haſtening the flowing, and ſomtimes the reflowing, and ſomtimes ſtaying and ſlacking them likewiſe.

There chanceth alſo, errour in the midſt of the motion of Waters; for as well courſes of Waters, as alſo flowings and reflowings, ſomtimes keep not the due motion. For (as it is ſaid) the diſpoſition of Winds may either increaſe or diminiſh their Courſes. Moreover, the ſtraitneſs and narrowneſs of places, by reaſon

ſon of the Iſlands and Mountains, cauſe great Concourſes and Diverſities in many places. For when the Sea is ſtraiter or narrower, there is the ſtrongeſt courſe, as about the Iſland *Eubœa*, *Nigropontis*, and between *Cicilia* and *Calabria* is greatly obſerved. Such ſtraits hinder the increaſe of Waters, becauſe leſs quantity paſſeth thereby, and therefore there the flowings & reflowings are leſs. And hereupon it happeneth, that in the Ocean Sea are greateſt flowings and reflowings, becauſe there are no ſtraits which may hinder or ſtay the courſes of the Waters; and by that means they have their full and free courſe, and in more certain order: But in the *Mare Mediterraneum* it is otherwiſe, for whatſoever Water of the Ocean entreth therein, or cometh forth, paſſeth from the Weſt by one only narrow ſtrait; and therefore it cannot in the flowing be greatly filled, neither in the reflowing be greatly emptyed. And ſo conſequently the motion of the motion of the Sea proceedeth not in certain order.

The

The Closset of Magnetical Miracles Unlock'd, or the properties and secrets of the Load-stone Reveal'd, serving not only for Sea Affairs, but also for Travelling by Land; for moveable Dyals, for the more ready and exact Chorography in any Countrey; the Plotting of any Ground, the following of a Mineral Veine; as also useful for Pioners and Diggers of Mines, &c.

NExt to the Inventions of Printing and Guns may be added the *Marriners* Compass, of which *Bodin* thus Confidently speaks, *Cum Magnete nihil sit Admirabili magis in toto rerum natura, usum tamen ejus plane divinum Antiqui ignorarunt*: Though there be nothing more admirable then the Load-stone in the whole course of Nature, yet of the Divine use of it were the Ancients ignorant: and *Blondus, certum est Navigandi auxilium Priscis omnino fuisse incognitum*: It is certain that the help of Sayling was altogether unknown to the Ancients. And *Cardan*, a Man much versed in the rarities of Nature, *inter ceterum rerum inventa admiratione primum dignæ est vasis Nauticæ pyxidis*: Amongst other rare Inventions, that of the *Marriners* Compass is most worthy of admiration. By means of it was Navigation perfected; the Lives and Goods of many thousands have been, and daily are preserved; it finds out a way thorow the vast Ocean, in the greatest Storms, and darkest

darkest Nights, where there is neither Path to follow, nor Inhabitant or Passenger to inquire: it points out the way to the skilful Marriner when all other helps fail him, and that more certainly though it be without reason, sense and life, than without the help thereof all the Wizards and Learned Clerks in the World, using the united strength of their Wits and Cunning can possibly do: by means of it are the Commodities of all Countreys discovered, Trade, Traffique, and Humane Society maintained; their several forms of Government and Religion observed, and the whole World as it were made one Common-wealth, and the most distant Nations fellow Citizens of the whole Body *Politick*.

This wonderful Instrument we have described by several Authors, but for the reason thereof, I say with *Acosta*, *Let others search out the causes of this so wonderful an Instrument, and pretend therein I know not what Sympathy, I for my part as oft as I look upon it, I cannot but exceedingly admire, and most willingly praise the Power and Providence of God.*

Whether it were known to the Antients or no, some doubt is moved, as of all things else there is: but herein, in my Judgment, without any sufficient reason. For can we conceive that so rare a device and of so singular use could be known to *Aristotle*, *Theophrastus*, *Pliny*, *Dioscorides*, *Galen*, and that we should no where in any of their Works find the least mention of it? Surely, I for my part can never believe it, neither can I be perswaded that so pretious and useful an invention could possibly be entertained and commonly practised, and yet lost out of the World as if it had never been; but that indeed it was not practised, appears by this, that the Ancients, when by a Storm or Mist they had lost the sight of the Lights of Heaven, they had no remedy to fly unto; as *Blondus* saith: *Nullum Cœlo Nubibus obscurato Medicamentum aut alio instrumento petebant auxilium*, when the Hea-

ven

ven was darkned with Clouds, they had no assistance from the Load-stone or any other instrument. As *Virgil* hath it in his 5th *Æneid.*

——Clavumque affixus et hærens
Nunquam amittebat oculisque sub astra tenebat.

The Helm he held, and never it forsook,
But on the Stars his Eyes did ever look.

Saith the Poet, as long as the Stars appeared; but when they were Bemisted, they then wandred they knew not whether. As *Virgil* hath it again in his Third *Æneid.*

Tres adeo incertos cæca caligine soles,
Erramus Pelago, totidem sine sidere Noctes.

On Sea we roved three days, as dark as Night,
Three Nights likewise, not seeing Starrie Light.

And in St. *Pauls* Coasting-Voyage by Sea, when that they had lost the sight of the Sun and the Stars, all hope that they should be saved was taken away.

A great doubt presents it self to us, which is about the time and Author of this Invention, when and by whom it should first be found out and set on foot. Doct. *Gilbert* our Country-man (who hath Written in Latine a Large and Learned discourse of the properties of the Load-stone) seems to be of the Opinion that *Paulus Venetus* brought the Invention of the use thereof from the *Chineses*. *Osorius* in his discourse of the Acts of King *Emanuel*, refers it to *Gama* and his Country-men the *Portugals*, who as he pretends, took from certain Barbarous *Pyrates* roving upon the Sea; about the Cape of good hope. *Goropius Becanus* likewise thinks he had great reason to Intitle it upon his Country-men

the

the *Germans*, in as much as the 32 Winds upon the Compass borrow their Names from the *Dutch* in all Languages. But *Blondus*, who is therein followed by *Pancerollus*, both *Italians*, will not have *Italy* loose the praise thereof, telling us that about 300 years agoe, it was found out at *Malphis* or *Melphis*, a City in the Kingdom of *Naples*, in the Province of *Campania*, now called *Terra di Lavoradoe*; but the Author of it the one names him not, and the other assures us, he is not known: yet *Salmuth* out of *Ciezus* and *Gomara* confidently Christens him with the Name of *Flavius*, and so doth *Du Bartas* in those excellent Verses touching this Subject.

W'are not to Ceres *so much bound for Bread,*
Neither to Bacchus *for his Clusters Red,*
As Signior Flavio *to thy witty Tryal,*
For inventing of the Sea-mans *Dyal;*
The use of the Needle turning in the same,
Divine device, O! admirable frame,
Whereby thorow the Ocean in the darkest Night
Our huge Carracks are conducted right,
Whereby we are stored with Trouchman, Guide & Lamp,
To search all Corners in the watery Camp.
Whereby a Ship that stormy Heavens have whirl'd,
Near in one Night into another World,
Knows where she is, and in the Card descries
What degrees thence the Equinoctial lyes.

It may well be then that *Flavius* the *Metuitan*, was the first Inventor of guiding of a Ship by turning the Needle to the North: But some *German* afterwards added to the Compass, the 32 Points of the Wind in his own Language, whence other Nations have since borrowed it. But surely great pitty it is that the Author of such an Invention, is not both more certainly known and more honourably esteemed. He is better in my

my judgment to be inrolled and ranked amongst the great Benefactors of the World, then many who for their suppofed Merits of Mankind were Deifyed amongst the Heathens, So that it may be said of the Inventor,

Exegit Monumentum ære perennius
Regaliq; ſicu Pyramidum altius.

Queſtionleſs thoſe of former Ages were for want of this knowledge ſo ignorant of the Art of Navigation that they ingraved *non Ultra* on *Hercules* Pillars, that the Nations about *Pontus*, thought no Sea in the World like their own, and doubted whether there were any other Sea but that only, whereof it came that *Pontus* was a word uſed for the Sea in general, that the *Egyptians*, held otherwiſe a witty people, uſed to coaſt the ſhores of the Red Sea upon Rafts, deviſed by King *Erythrus*: And in the time of the *Romans*, the *Brittains* our Anceſtours had a kind of a Boat (with which they croſt the Seas) made all of twigs and covered with Leather, of which *Lucan* the Poet.

Primam cunæ ſalix madefacto nimine parvam
Texitur in puppim, cæſoque inſuta juvenco
Vectoris patiens, tumidam ſuperenatat alvum.
Sic Venetus ſtagnante Pado fuſcique Britanni
Navigat Oceano:

The moiſtned Oſyer of the hoatie Willow
Is Woven firſt into a little Boat,
Then cloathed with Bullocks hide upon the Billow
Of a proud River Lightly doth it Float,
Under the Waterman.

So on the Lakes of overſwelling *Po*,
Sailes the *Venetian*, and the *Britains* ſo
On the outſpread Ocean.

And

And to the like purpose is what of *Festus Avienus.*

Navigia junctis semper aptant pellibus,
Corioque vastum sæpe percurrant salum.

Of stiched hides they all their Vessels had,
And oft through Sea, in Leather, Voyage made.

But that which is more observable is, that the *Jews* were so unskilful in this Art, as they commonly called the Mediterranean Sea, the great Sea; not being in those times, as it seems, much acquainted with the Ocean. And though the *Phenicians* and *Carthaginians*, the *Tyrians* and the *Sydonians*, are much renowned in Histories, for great Navigators; yet it is thought by the Learned, that those Voyages they performed, was only by coasting, and not by crossing the Sea.

—Hæc ipsa quod fata negarunt
Antiquis totum pervius sulcare carinis
Id Pelugi immensum quod circuit Amphitrite

This age what fates to former times deni'd
Through the Vast Ocean now in Ships do ride.

Saith *Fracastorius*, and adds, *Equidem Navigationem altissimo Oceano commissam neque apud Veteres Lego, neque apud illis aliter Oceanum Navigntum puto qusm a nostris Mediterraneum.* That the Antients adventured themselves into the Main Ocean, neither do I read it in any of their Histories, nor do I believe that they otherwise sailed along the Ocean, then we do now over the Mediterranean Sea, and it should seem they undertook not their longest Voyages without Oares, which the Scripture implies in that undertaken by *Jonas*, where the Marriners upon the rising

of a Violent Tempeſt were conſtrained to uſe their Oars.

The perfection then of this Art, ſeems by God's Providence to have been reſerved to theſe later times, of which *Pedro de Medina*, and *Baptiſta Ramuſio* have given excellent Precepts. But the Art it ſelf hath been happily practiſed by the *Portugals*, the *Spaniards*, the *Hollanders*, and our own Nation, whoſe Voyages and Diſcoveries, Maſter *Hacklait* hath collected and reported in ſeveral Volumes, inlarged and perfected by Mr, *Purchas*, and it might be wiſhed as well for the Honour of the *Engliſh* Name, as the benefit that might thereby redound to other Nations, that his Collections and Relations had been Written in *Latin*, or that ſome Learned Pen would be pleaſed to turn them into that Language. Among many others in this kind, the Noble ſpirited *Drake* may not be forgotten, who God being his Guide, Wit, Skill, Valour and Fortune his Attendants, was next after *Magellanus* that Sailed about the World. Whereupon one writ theſe Verſes unto him.

Drake *Peregrati novit quem terminus Orbis*
Quemque ſemel Mundi vidit uterque Polus:
Si taceãt homines facient Te ſidera notum
Sol neſcit commitis immemor eſſe ſui.

Sir *Drake* whom well the Worlds end knew,
Which thou didſt compaſs round:
And whom both Poles of Heaven once ſaw,
Which North and South do bound.
The Stars above will make thee known
If men here ſilent were:
The Sun himſelf cannot forget
His Fellow Traveller.

P. Columbus, being in the company of some braging prating fellows, amongst other of their fooleries they fell upon him, and said he had done nothing but they could do. After he had patiently heard them, he called for an Egg, and asked which of them could make it stand upon one of the ends, they said they could not do it; why then says he I can, and breaking one of the ends, he fixt it. Why said they this we can do, yes verily says he without doubt, this is but an easie enterprise, yet this you could not do till you have seen me first do it.

For the better breeding, continuance, and increase of Pilots amongst us, it would doubtless be a good and a profitable work (according to Mr. *Hucluit*'s honest Motion in his Epistle Dedicatory to the Lord Admiral) if any Man who hath the means, had likewise the mind to give allowance for the reading of a Lecture of Navigation in *London*, in imitation of the late Emperour *Charles* the Fifth, who wisely considering the rawness of the Sea-men, and the manifold Shipwracks which they sustained in passing betwixt *Spain* and the West *Indies*, established not only a Pilot Major for the examination of such as were to takes charge of Ships in that Voyage, but also founded a Lecture for the Art of Navigation, which to this day is read at the Construction-house at *Sevil*; the readers of which Lecture have not only carefully taught and instructed the *Spanish* Marriners by word of mouth, but have also published several exact and worthy Treatises concerning Marine causes, for the direction and incouragement of Posterity: and namely these three, *Alonzo de Chanez*, *Hieronimo de Chanez*, and *Roderigo Zamerum*, and to this purpose it was a commendable work of Mr. *Gelibrand* Reader of *Gresham-Colledge* for the improvement and advancement of the Art of Navigation published a most excelent Book of *Logaritbmes*.

But to return to the Sobject we have now in hand, con-

oncerning the nature, powerfulneſs, and ſtrange pro-
erties of the Load-ſtone are ſuch, that the more they
re known, the more they are juſtly admired in their
noſt Lively expreſſing that infinite power and goodneſs
f God, who Created ſo pretious a Jewel for the profi-
able uſe of Man, and for the inlarging and ſetting forth
f his lory. Into the ſearch of which admirable and
ecret Virtues, my ſelf for the ſpace of ſome years
ave made a ſtrict Inquiry, partly by Reading of other
nens Writings, and partly by my own Induſtry and
ractice: whereby what I have collected and found,
his little Treatiſe will ſhew.

I doe acknowledge that the wonderful property of
he body of the whole Earth, called the *Magnetical Vir-
ue* (is moſt admirably found out, and Learnedly diſ-
courſed by Doctor *Gilbert*, Phyſitian to the renowned
Queen *Elizabeth*, of happy Memory) is the
very true Fountain of all *Magnetical* Knowledge, for
ll our later Authors have but borrowed from this
Country-man of ours. And though certain properties
f the Load-ſtone were known before his time, yet all
he reaſons of thoſe properties were altogether un-
know, and never before revealed as I take it to the
ons of men. And although as yet many doe doubt and
miſtruſt the Earth it ſelf hath no ſuch Virtue, I doe no-
hing wonder at it, becauſe before I read his Learned
Works, and had tryed many of his Experiments with my
wn hands, and had confered with great Travellers,
nd peruſed the obſervations of our chiefeſt *Navigators*,
oth for the Variations and Declinations, I never be-
ieved it my ſelf. But this I may truly affirm, that
earching with diligence his firſt fine Books, and mak-
ng Tryal of thoſe Propoſitions which I judged to be of
mportance, I always found the main drift touching
his point, conſtant and agreeable to the diligent Ob-
ervations of many men of Experience; although in
ome other matters of the Load-ſtone his Experiments and

mine

mine did ſometimes diſagree. But concerning his firſt Book Entreating of the motion of the Earth; I think there is no Man living further from believing it then my ſelf, being nothing at all perſwaded thereunto, by reaſons of other men, which he alledgeth, and as little or leſs (if it were poſſible) by thoſe his Inventions, endeavouring to prove the motion of the Earth by the Earths Magnetical Force and Virtue. *Amicus Socrates, Amicus Plato, ſed Magis amica veritas* is the only cauſe why I do embrace his judgment in the one, and refuſe it in the other, in matters of this nature following this Rule.

Nullius addictus iurare in Verba Magiſtri.

Reader be pleaſed to paſs by this digreſſion, we are to return hearty thanks to God, who hath revealed unto the weak Knowledge of Man, now towards the end of the World, this admirable Treaſure, before unknown, of his powerful Creation, by effect ſo plain unto the meaneſt Capacity: and that out of a baſe contemptible and dead a Creature, as it ſeemeth to be, and yet filled with ſuch excellent wonderful Virtue, that all the Gems of the World have not the like; neither if it were wanting, could they ſupply the want thereof, or countervaile the Benifit that it brings to the Life of Man.

Claudian (a Famous Poet) well near Twelve-hundred years ſince, ſaith as much commendations of the Magnet, when as yet the Sereditical or Iron drawing Properties was only known.

.....Lapis eſt cognomine Magnes
Decolor, Obſcurus, nilis, &c.

And again.

Sed Nova si nigri videas miracula ſuci,
Tuno ſuperet pulchros cultus, et quicquid Eois
Indus Littoribus rubra ſeruatur in alga.

But what would he not have ſaid, had he ſeen the Cloſſet indeed of all Magnetical Miracles Unlocked, and in ſo glorious a manner ſet wide open, as now it is at this day, had he had Load-ſtones of divers forms, but eſpecially round ones: alſo ſuch Verſory Needles fitly framed, and Artificially placed upon their Pins and other Implements, as are prefcribed; wherewith being furniſhed, he might ſtill ſee the Truth of them in things themſelves, for theſe ſkills muſt be Learned, *ex rebus ipſis non ſolum ex Libris*, and withall there are ſeveral Figures and Diagrams which cannot be underſtood, but by the help of the *Mathematicks*, and good Travelling in the *Magnetical* Practice.

To be ſhort, of all that I have ſet down in this Treatiſe, my requeſt is, that the Reader will admit nothing but that which ſhall be confirmed by good Reaſon or undoubted Experience. And I purpoſe God willing, to tye my ſelf as ſtrictly unto this Rule, as ever any Man did that hath Written of the like Argument, making it even a matter of Conſcience to deliver any thing herein, for certainty, that my ſelf ſhall not know to be ſound. And ſo by this means I ſhall neither abuſe the Reader with any untrue aſſertion, nor injure ſo certain and ſo excellent a Knowledge, with any doubtful or reproveable Concluſions.

It is a common Proverb, that in Stones, Woods and Herbs, conſiſteth great Virtue: which ſaying is doubtleſs moſt manifeſt by the daily experience of the Load-ſtone, found in ſundry parts of *India*; ſome will have it to be found in *Spain*, by one Named *Heraclon* (as *Hi-*

cander ſaith) where, in the time of his keeping of Cattle, the Iron Nailes of his Shoos and Pike of his Staff cleft faſt to the Stone. Of theſe Magnets are five ſorts or kinds, as *Soracus* writeth: One of *Æthiopia* another of *Macedonia*, a third in *Echio* of *Boecia*, the fourth at *Troades* of *Alexandria*, the fifth of *Magneſia Aſia*. The difference of the ſtone is, whether it be Male or Female. The next difference is in Colour; for that which is found in *Macedonia* and *Magneſia*, is ruddiſh and black, and of Female kind, and therefore without Virtue. The worſt of *Magneſia Aſiæ* is white, and attracteth not Iron, it is like unto a *Pumice* ſtone. Some approve thoſe for the beſt which are Blew, of a Heavenly colour. That of *Æthiope* is moſt praiſed (and as *Pliny* ſaith) is ſold for the weight in Silver. This is found in *Zimri*, a ſandy Region of *Æthiope* where is alſo found *Hæmatites Magnes*, of Bloody colour, appearing like Blood if it be ground, and alſo like Saffron, which in drawing of Iron is not of the like virtue to the *Hæmatites Magnes*. All theſe are reputed good Medicines for the Eyes, each of them according to their Portion, and doe eſpecially ſtay the *Epiphora* (that is) the dropping and watering of the Eyes; and alſo being burnt and made in powder, they heal Burnings. Not far from the ſame place in *Æthiopia*, is a Mountain which produceth the ſtone called *Theamedes* which putteth from it, and refuſeth Iron. I have often proved the virtue and power of the Load-ſtone, by the Needle which is in ſome Dyals, by the attraction thereof, moving it ſelf from ſide to ſide, and round about. And as we ſhall hereafter more fully ſhew, although the ſtone were under a Table, yet doth the Needle being above the Table, naturally follow the moving of the ſtone. It is therefore (for this we only inſert by the bye) if there be great virtue in Stones, Woods and Herbs. It hath alſo been proved that the Ships Compaſs with Iron Nailes, Sayling by the Sea of *Æthiope*

and

nd by a Tempeſt driven to Land, to certain Capes or Lands ends, have by theſe ſtones either been drawn to the bottom of the Sea, or elſe the Nailes being drawn out by the Virtue of the ſtone, the Ship hath falen in a thouſand pieces. And therefore the diſcreet and wary *Cantabrians*, expert Mariners Saying by the *Æthiopian* Sea, frame their Ships with Pins and Hoops of wood, to prevent the danger that might chance on the ſame occaſion.

This ſtone is known by colour, virtue, weight and equality, the beſt colour is ſaid to be like pure Iron, ſhining, mixed with Indian or Heavenly colour, and is in a manner like Iron Poliſhed. This ſtone is alſo often times found in *Norway* and *Elua*, and in certain Regions of the *North*, and is brought from thence to certain Regions in *Normandy* and *Flanders*. The experience of the virtue of the ſtone, is eaſie, for it attracteth to it a great weight of Iron, it is judged to be ſtrong, and the heavier alſo the better. By equality it is judged, if it be alike in one ſubſtance and colour: but if it be unequal with chapes (as we ſhall hereafter expreſs) together with hollow places indented, having red ſpots here and there, it is unapt not ſo fit for the Art of Navigation, or of continual Motion. It repreſenteth the ſimilitude of Heaven, for like as in Heaven there are two points immoveable, ending in the Axle-tree of the Sphere, upon which the whole Frame of Heaven is turned (as may be experienced by the Art that Chriſtal and other ſtones are Poliſhed) even ſo the Load-ſtone reduced into a Globious or round Form, laying thereon a Needle or any other like Iron, then which way ſoever the Needle turneth and reſteth, thereby is ſhewed the place of the Poles; and that this may be done more certainly, it muſt be often times attempted, and the Line ſhewed by the Needle, muſt be obſerved, for ſuch Lines ſhall cut the one, the other in two Points, as the *Meridian* Circles joyn together

the Poles of the World: but of this also, more shall hereafter be said. This shall for the present be only intimated.

That if the round stone (as is said) be found in the place which often times draws Iron, if then the point doe exactly appear, part of the broken Needle must be laid upon the stone, and be so often by little and little transposed, untill the Style or Pin be Perpendicler, or Plummet do directly fall upon the stone, for there on the contrary part, by like manner shall be found the other Pole. *A.* shall be the true point, and *B.* the false.

Load-stones, let them be of what parts soever of the World, have the self same general directive property. I mean, of shewing the North and South, and also the self same Points respective, declining or dipping under the Horizon. They do likewise agree in their variations, and each one will draw Iron, and likewise one another. Every Load-stone, of what form soever it be, hath either actually or potentially two points, the one Northern, the other Southern. Actu-

actually, if either by casualty (if it so fall out) or by industry the stone be fashioned, that those two opposite points be eminent or perspicious therein; Potentially, if that either the stone be flat, and but thin in the dimension of the North and South, though broad otherwise, for so shall the virtue of the stone be dispersed to the extream parts thereof, in the Edges round about; or if it have two opposite points in any concavity, then will the stone shew in the eminent Border or Edge of that concavity only a confused dull force, and in the concavity very little or nothing at all. That stone is also well proportioned for touching which resembleth an Oval form, and hath his due points in his ends, and is void of any bunch or concavity; for the general form of a stone being good, every concavity is a diminishing of his force, and every bunch is a superfluous burthen: Insomuch, that my self have had experience of a stone, that of substance was very good, and of weight was three and twenty ounces, but of disordered form, it therefore took away twelve ounces from him, and yet diminished not one jote of his force. And this I did in a stone that was all of like force, but if it be one that is intermixed of divers substances (as many such there are, and those easily discovered by their colour) you may sometimes take away three quarters or more of his substance without diminishing any thing at all of his virtue: we have already said the Iron colour is best; very black or white (colours proper to Agat) indifferent; the [illegible] in any stone, [illegible] much the [illegible] retain the eye of Iron colour, [illegible] stones are good and some

[illegible] Magnet be [illegible] bare [illegible] to a Knife, or any thing to lift from the ground, it will with good strength move a Magnetical Needle a pretty good

the Poles of the World: but of this also, more shall hereafter be said. This shall for the present be only instanced.

That if the round stone (as is said) be found in the place which often times draws Iron, if then the point doe exactly appear, part of the broken Needle must be laid upon the stone, and be so often by little and little transposed, untill the Style or Pin be Perpendicler, or Plummet do directly fall upon the stone, for there on the contrary part, by like manner shall be found the other Pole. *A.* shall be the true point, and *B*, the false.

Load-stones, let them be of what parts soever of the World, have the self same general directive property. I mean, of shewing the North and South, and also the self same Points respective, declining or dipping under the Horizon. They do likewise agree in their variations, and each one will draw Iron, and likewise one another. Every Load-stone, of what form soever it be, hath either actually or potentially two points, the one Northern, the other Southern.

Actu-

Actually, if either by casualty (if it so fall out) or by industry the stone be fashioned, that those two opposite points be eminent or perspicious therein: Potentially, if that either the stone be flat, and but thin in the dimension of the North and South, though broad otherwise, for so shall the virtue of the stone be dispersed to the extream parts thereof, in the Edges round about; or if it have two opposite points in any concavity, then will the stone shew in the eminent Border or Edge of that concavity only a confused dull force, and in the concavity very little or nothing at all. That stone is also well proportioned for touching which resembleth an Oval form, and hath his due points in his ends, and is void of any bunch or concavity; for the general form of a stone being good, every concavity is a diminishing of his force, and every bunch is a superfluous Burthen; Insomuch, that my self have had experience of a stone, that of substance was very good, and of weight was three and twenty ounces, but of disordered form, it therefore took away twelve ounces from him, and yet diminished not one jote of his force. And this I did in a stone that was all of like force, but if it be one that is intermixed of divers substances (as many such there are, and those easily discovered by their colour) you may sometimes take away three quarters or more of his substance without diminishing any thing at all of his virtue; we have already said the Iron colour is best; very black or whitish seldom proves good; gray indifferent; the more white is in any stone, so much the worse. There are certain stones of an Iron colour, mingled with red, of which some are good and some bad. [illegible]

[illegible] ways you may prove whether a Magnet be good; the one is by taking up Iron with the bare stone; the other by giving more or less power to a Knife, or any thing to lift Iron; the third is if it will with good strength move a Magnetical Needle a pretty good

 distance

distance off, and readily alter the ends of the Needle without touching them, making the North South, and the South North: the two latter do never fail, but the first doth divers times. And very certain it is, that whatsoever Stone doth most strongly impart his force to a Knife, or move a Needle with quickness, the power and lifting up of Iron is such a one, will mightily be increased with a Cap. For this is generally the nature of all Magnets, that if there be two of different quantities, and of equal strength in lifting up Iron, the greater will give the stronger touch, and move a Magnetical Needle farther off, although the lesser will take as much Iron, or something more than the greater. And again, suppose there be a Load-stone of a pound weight, that being fitly armed, will take up four pounds of Iron, and not above, if you divide him into very small pieces, you shall find of them, being orderly used, that will lift up twenty times his own weight and a great deale more, if they be very small, as of three or four Grains weight; and yet where the great one will give a touch unto a Knife for to take up four ounces of Iron, and will move a Magnetical Needle three foot off; this little one will not give a touch to a Knife to take up a Needle, nor move a Magnetical Needle four inches off; that as a Magnet is [illegible]

[illegible]

many times their own weights. And very often is seen, that Magnets being of like form and weight, but

of

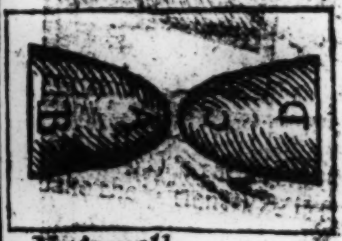
f divers kinds, the one will take up more Iron of him-
lf without the Cap, and yet the other give a far ſtron-
er touch; but then, if you do fit both of them accord-
ngly with Caps, he which gave the ſtronger touch,
ill take up more Iron then the other. The principal
orce of the Load-ſtone well proportioned, paſſeth in
direct Line from the middle of his ſubſtance, being
(as it were) a center, through his two ends or points,
which are the imaginary likes of his chiefeſt force, from
which center, there ille infinite others alſo through all
parts of the ſuperficies of the ſtone on either ſide, be-
tween the two extream points of the middle, all which
on either ſide of the middle, being of one nature and
property, in reſpect of their touch are exceedingly
different in ſtrength, for that ſtill waxeth leſs and leſs
as it approacheth, continually nearer and nearer the
middle, where at length in the middle, between the
two ends, it utterly fainteth and cometh to nothing.
The Load-ſtone communicateth his property to the
Iron or Steel that is touched with it, ſo far forth, as
the Iron or Steel which is touched, hath the ability to
receive, and ſo that good ſkill in the touching be obſer-
ved, Steel is far better then Iron, and receiveth a far
ſtronger touch, and much more effectual. The purer
Steel, ſo much the better; and if it be Iron, the purer
likewiſe the better, always regarding that both of them
be very ſmooth and clean, and have their due temper.
The principal property in common uſe, is the ſhewing
of North and South in the Horizon, with the appendants
thereunto belonging, which is more apparant, more
ſtrong, and more commodious in the Iron and Steel,
that is touched, then it is in the ſtone it ſelf, becauſe
the ſubſtance of them may be filled and cut away, and
drawn into any form that we like or approve of our
ſelves, which the ſubſtance of the ſtone will not per-
mit, The Lood-ſtone is of ſuch a nature, that every
piece broken off and ſeperated from the whole, hath all

the properties of the whole, the same several points North and South, and ability also for the touch, like in kind, though not of equal power, according to the quantity and proportion of the Piece, and the part of the Stone that it is taken from, and this property in a meaner sort hath touched the Needle and the Wyar of a compass also.

That one stone may draw another, lay the one upon a board or box in the Water, that it may freely float. and hold another in your hand, If then the North part of the stone, which you hold in your hand, you turn towards the South part of that which floateth in the box, or otherwise the South part to the North, the floating stone shall turn towards your hand, and if contrarywise, you turn the like part to his like, that is to say, the South part to the south, &c. the floating Stone shall fly from you. By this experiment certain Philitians are confuted, who dispute on this manner, If *Scammones* draw unto it choler, by Similitude or Likeness of Nature, *Ergo*, much more should one Magnet draw another, rather then Iron: So that what they assume falsely we have now taught to be true. The like judgment is of the long slender Iron which is rubbed with the Stone; For if in the Water it be laid on a light piece of Wood, or a straw, or such like, so that it may freely float upon the Water, the one end of it shall turn to the North, and the other to the South. And if holding the Stone in your hand, you turn his North point to the South extremity or end, or contrarywise, the Stone shall then draw Iron, but contrarily, if you turn the like part to the like, (as is aforesaid) it shall fly from the Iron and drive it away.

The

Impossible. Impossible.



Naturall.

The reason is, that the agent doth not onely indeavour to make the patient like it self; but also in such a manner to unite it with himself, that of them two be made one, as may appear by this reason. Take the same Magnet *A D.* of which *A* signifieth the North point, and *D* the South. Divide the Stone into two parts, *A B.* and *C D.* put *A B.* to the Water as is said, and by this means you shall see *A.* turn to the North and *B* to the South. For the breaking or dividing of the Stone (as we said) diminisheth not the Virtue thereof, so that it be *Homogenie*, that is, all parts alike. Take therefore *A B.* for the patient, and *C D.* for the agent, then whereas the agent, in the best manner it may, worketh to conserve the order of Nature, it is manifest that *D.* cannot draw *C.* the South: for although they could by that means be joyned, yet should not so be made one of them two, the parts

remaining in their Vertue: For if *A.* should remain North, then *B.* should be South, which is certain to have the power of the [illegible]

Neither contrariwise shall *C.* draw *A.* for both are Northly, and so should *B.* be the North which first was South, and *D.* in like manner: For so should the order of Nature be inverted. It remaineth therefore that *A.* shall naturally draw *D.* and *B.* shall draw *C.* for so every way shall remain of equall strength. Some ignorant Men were of opinion, that the Vertue of the Load-stone was not derived from Heaven, but rather of the nature of the place where it is engendred, saying that the Mines thereof are found in the North, and that therefore ever one part of the stone extendeth towards the North. But they surely are ignorant that this stone is found in other places whereof it should as well follow that it should extend it self to other and divers parts, as to the North; which thing

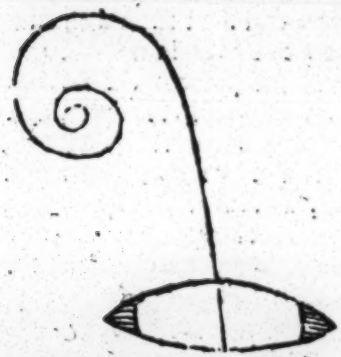
thing is falſe, as is well known by common experience, For it ever Moveth to the North in whatſoever place it be. Neither is it to be believed, that the North-Star of the Marriners is the Pole: For as much as that Star is without the Meridian Line, and but twice within one revolution of the Firmament. But whereas the Marvelous Vertue of this Stone dependeth of Heaven, who would believe that only two points thereof ſhould ſo turn themſelves, and that rather every part of it ſhould not incline to ſome like part in Heaven, as may thus be proved. Let the Stone be brought into a Spherical round forme, as is ſaid, and the Poles being found, let it be turned upon two pins, or Turners inſtruments, and there be pullyſhed, untill it be on every part of equall heavineſs, which you may well find by often proving: For that part that falleth down is heavieſt, which done, frame in a Meridian Circle with the Horizon, wherein faſten two other pins on which it may eaſily move, and divide the Poles moſt exactly to the Poles of the World, the which if it come well to paſs, rejoyce that then you have found one of the greateſt Miracles of Natural things. For you ſhall by this means ſee the Aſcendent, the place of the Sun, and the like, &c. at every Moment. But if it fall not out according to your deſire, you ought not to impute that to the Art, but to your own ignorance and negligence, For if you execute and perform all things duly and aright according to Art, you need not to doubt the ſucceſs.

How theſe Inſtruments by this Stone may be framed, by the which may be found the *Azimuths* of the Sun and Star (that is to ſay, Verticall Circles) it ſhall not here be neceſſary to ſhew, foraſmuch as the ſame is eaſily done by the Marriners Compaſs, or by the Box with the *Magnes* or Load-ſtone incloſed, and floating above the Water, with a pin erected, and in the uppermoſt part divided into 360 parts, after the manner of Aſtronomy.

That

That you may eaſily find out the chief points of any Load-ſtone of what forme ſoever, you muſt make a reſpective or declinatory Needle, of an Inch or thereabouts in length, and giving him his touch, faſten him by the *Axis* upon a little forked ſtick, or any thing like it, that the Needle may have free ſcope, then offer the Stone (as we ſaid before) near the Needle, turning of it round about, and immediatly you ſhall ſee the North of the Needle (as it is as yet commonly called, becauſe it pointeth toward the North) point directly unto the true North end of the Stone as ſoon as it commeth near unto it, and as you turn away the end of the Stone, the Needle will point ſomewhat towards it, till the South end of the Stone approacheth (as we have in part declared) for then will the Needle wheele about the *Axis*, and point directly with his South, and to the South of the Stone. But if you hold the Needle near to the Stone, in ſuch ſort that it cannot turn about at liberty, then the force of the Stone may ſoon change the properties of the ends of the Needle, that the one point which was North ſhall become South, and that other which was South ſhall become North, yet the thing it ſelf is eaſily diſcerned: for the Northerly end will alwayes hang lower.

And



And whereſoever the Needle, being held nearer to the ſtone, doth ſtand parallell unto it, not inclineing with either end towards the ſtone, there directly, under the middle of the Needle, the North and the South properties of the ſtone do divide and part themſelves. This matter is much better performed with a ſmall narrow Load-ſtone of half an Inch (more or leſs) in length, haveing in the ends his due points of North and South and wrought over with ſilk of two colours from the middle to each end; as for Example, Yellow and White; that part which pointeth over to the North let it be wrought over with White, and the other with Yellow. Then if you hang that in the middle by a fine ſilk thred, and apply it to any other Load-ſtone, the South end of the one will readily find out the North end of the other; and contrarywiſe, In like manner, with this Magnetical Inſtrument you may ſee two pretty concluſions. The one if you touch a knife with the end of a forceable Load-ſtone, whether it be North or South, and hang this wrought on by a ſilke thred in the middle, that it may hang freely, the one end will crave towards the point of the knife, and the other will not abide it. The other

other is, if you hang it end long, with the true North end, right over the North end of a forcible Load-ſtone, or with the South end over the South end of the other, you ſhall ſee that it will in no wiſe (being let down) come unto the North point of the Load-ſtone, but will (contrary to Phyloſophycal Principles, that heavy things ſhould tend directly downwards) by the means of the Silk Thread, ſwim or wheele the end of the Load-ſtone in the Air: yea, and lift it ſelf ſomewhat upwards, rather then perpendicularly light down upon it; yea, that it will doe although you place a Plate of Silver or Braſs, or any ſuch thing, between the ſtone and it ſelf.

The ſecond way is to take a Thread of a common Sowing Needle, and touch the point of it with the North end of a Load-ſtone whoſe points you would find out, holding the Needle about an Inch from it, and in turning the ſtone about, you ſhall preſently ſee the Needle point to the North end, when by your turning it cometh near. The contrary effect enſueth, if you touch the point of the Needle with the other end of the ſtone, wherein you may behold that ancient conceived, and of late years maintained opinion of the contrariety of the Load-ſtone and the Theamedes to be no otherwiſe then a contrary property of one and the ſelf ſame Magnes.

The third way, is to breake off the point of a Sowing Needle half an Inch or longer (if the ſtone be good) but not above a quarter of an Inch (if it be a baſe ſtone) lay it upon the ſtone, and move it to and fro upon the ſuperficies thereof (being ſmooth) with the Needles point forwards, and as it cometh near any of the two points of force, it will raiſe it ſelf more and more: but being brought unto the point it ſelf, it will ſtand there ſtrait upright; if the ſtone be ragged, this cannot be practiced, otherwiſe of all other it is the moſt certain way. Now whether it be your North or South end the effect will ſoon declare.

The

The fourth way is, that you having an ordinary Dyal, or a Sailing Compass, or any [illegible] Needle standing on a sharp point, hold [illegible] to the stone, touching it in your hand, the [illegible] North end of the Needle (I mean the end that pointeth to the North) refers the true North point of the stone.

The fifth way is also, if you touch a common Sowing Needle the longer the better, and put it through a little piece of [illegible] not bigger then may well bare it up, so that by the means thereof it may swim in a Bason of Water, the same if you offer the stone unto it, will shew the like effect. And here it is to be remembred, that none other way whatsoever will more readily or truely define the Magnetical *Meridian*. And therefore as it is very requisite for many purposes, that every Traveller by Land, but more especially by Sea, should always have (if he can) an equinoctial Dyal with him, so would I not wish that any of them should be without some Sowing Needles, touched with a good stone, which will both serve the proper uses of Sowing without impairing their touch (for it is open Air and Rust that are the greatest Enemies thereof) and at any time with a piece of Cork or a dry Stick in the Water the Magnetical *Meridian* may be seen; a matter though mean and trivial in shew, yet between whiles of so great importance, that it may serve to save many mens lives.

A sixt way is also, if you prepare a little round Loadstone of a quarter of an Inch *Diameter* or thereabouts (but it must be a very good one) having his Poles marked and fitted in such manner, that it easily turn about in a little Frame according to the following Picture. The like also in his manner will come to pass, if you have a small declinatory Needle in a frame, in this manner,

Then

Then by moving it in his Frame all over the ſtone, the North Pole of this will find the South of the other: and likewiſe will the South, the North of the great one; for it is not in outward ſhew one Magnet and another, as is between a Magnet and a Magnetical Needle, the contrary ends of the Magnet will covet in their motion to meet together, but the end of the Needle which turneth North will come unto the North of the ſtone: For in very truth it is the South point of the Needle, even as the Magnet it ſelf being placed in a Wooden Diſh in Water, will turn with his North end to the South, and with his South end Diſh and all, towards the North. The like effect will alſo follow if you hang as aforeſaid a ſmall Load-ſtone in the middle of a ſmall Silk Thread, and that it may freely turn without impediment, according to its nature; but this property it will ſhew quicker or ſlower, according unto the goodneſs of the ſubſtance and fitneſs of the form. The beſt form for this purpoſe is the extended Oval, having his Poles preciſely in the ends. If his Poles be ſome pretty diſtance, the one end towards the Eaſt of the ſtone, and the other as much towards the Weſt; this ſtone in his length will not point to the Magnetical North and South (as otherwiſe he would) but unto ſome other point of the Horizon: yea, following this experiment in this manner, you may make him ſtand in any one Point of the Compaſs: only

you

ou ought to abridge the ſtone in his length that he may ome ſomewhat nearer to a circular form, ſo that is diameter of North and South (being through the lagnetiſme of the Earth, the cauſe of this motion) ay be ſo much the longer in comparison of the Maſs of he ſtone, and conſequently more effectual. After the ke manner you may ſo touch the Wyars of a Com-aſs, that the Flower de Luce of the ſhie, ſtand unto hat point of the Horizon you pleaſe, although the iameter of the Wyars do ſtill remain fixed under the lower de Luce, and the ſouth point of the Card.

Finally to conclude this point with ſome Magnetical Delights, if you touch two Sowing Needles in a contra-y manner; that is, the point of the one Northerly, and he other Southerly, and ſet them with their Corks the ne at the one ſide of a Baſon of Water, and the other t the other, you ſhall ſee them, as quickned with Vital pirit, even ſo to move the one end towards the other at he firſt fair and ſoftly, but when they draw near they will ruſh together (as it were) with a kind Violence, he point of the one ſtriking preciſely at the point of he other, you muſt place the Needle, whoſe point is ouched for the North on the South ſide of the Baſon otherwiſe the heads and not the points will run to-gether; a thing far more worthy of admiration, then ll the ſelf movers of any *Bodin* or *Archita Tarenti-nu*, and more ſtrange to behold then the Connexion of Iron Rings combined by Virtue Magnetical, whereat St. *Auguſtine* ſo much, and that juſtly, did wonder.

Another excellent and ſecret concluſion upon this ſtone, pretended to be found out in theſe latter times; s, that by touching two Needles with the ſame ſtone, they being ſeverally ſet ſo as they may turn upon two round Tables, hanging on their Borders the Alphabet written Circuler wiſe, if two Friends agreeing upon the time, the one at *Paris*, the other at *London* (having each of them their Table thus equally fitted) be diſpo-

ſed

sed upon certain days and at certain hours to confer, it is to be done by turning the Needle in one of the Tables to the Alphabet, and the other by Sympathy will turn it self in the self same manner in the other Table, though never so far distant: Which conclusion if infallibly true, may likewise prove of good and great consequence: howsoever I will set it down as I find it described by *Faminanus Strada*, *Lib* 2. *Prolus* 6. in imitation of the Stile and Vain of *Lucretius*.

Magnes genus est Lapidis mirabile, cujus
Corpora ferrisus plura filo admoveris, inde
Non modo uim notumque trahunt que semper ad Ursam,
Quis lubet nicina polo se vertere tentent,
Verum etiam mira inter se ratione, modoque
Quotquot eum Lapidem tetigere filii simul omnes
Conspirare situm motumque videbis in unum.
Ut si forte ex iis aliquis Roma moveatur
Alter ad hunc motum quamvis sit disjitus longe,
Arcano se naturai fœdere vertat.
Ergo age quid si scire velis qui distat amicum
Ad quem nulle accedare possit Epistola, sume
Plumum Orbem patulumque unas, Elementaq; prima
Ordine quo discunt pueri, describe per oras
Extremas Orbis, mediog; supone jacentem
Qui tetigit Magnete stylum ut versatilis inde
Listernam quamcunq; velis contingere possit,
Hujus ad exemplum simili fabricaveris Orbem
Margine descriptum, munitumq; judice ferri,
Ferri quod motum Magnete accipit ab illo,
Hunc Orbem discessurus sibi portet Amicus;
Convenitaq; prius quo tempore, quisque diebus
Explores stylus ut trepidet, quid ve judice signes.
His ita compositi, si alas cupis alloqui amicum
Quem procul a Te Te terrai distinet ora
Orbi adjunge manum, ferrum versatile tracta,

His

Hic diſpoſta vides Elementa in Margine toto
Queis opus eſt ad verba notis huc dirige ferrum
Litterulaſq; modo hanc modo et illam cuſpide tange
Dum ferrum per eas iterumq; iterumq; rotando
Componas ſingulatim ſenſa omnia mentis.
Mira fides longe qui diſtat cernit amicus
Nullius impulſu trepidare volubile ferrum
Nunc huc, nunc illuc diſcurrere conſcius tueret
Obſervatque ſtoti ductum ſequiturque legendo.
Hinc atq; hinc Elementa quibus in verba coactis
Quid ſit opus ſentit ferroque interprete diſcit.
Quin etiam cum ſtare ſtylum videt, ipſe viciſſim
Si quæ reſpondenda putat ſimili ratione
Litterulis varie tactis reſcribit amico,
O Utinam hæc ratio ſcribendi prodeat uſu
Cautior et citior properat Epiſtola, nullas
Latronum verita inſidias fluvioſque Morantes
Ipſe ſuis princeps manibus confecerit rem
Nos ſoboles ſcribarum emerſi ex æquore Nigro
Conſecraremus calamum Magnetis ad aras

Thus Engliſhed.

The Load-ſtone above all other Stones hath this ſtrong property,
If ſundry ſteels thereto, or Needls ye apply,
Such force and motion thence they draw, that they incline
To turn them to the Bear which near the Pole doth ſhine.
Nay more, as many ſteels as touch that Vertuous Stone,
In ſtrange and wondrous ſort conſpiring all in one,
Together move themſelves, and ſcituate together:
As if one of thoſe ſteels at *Rome* beſtirred, the other

Well

The self same way will stirre though they farre di-
stant be,
And all through Natures force and secret Sympathie:
Well then if you of ought would fain advise your
Friend
That dwells far off, to whom no Letter you can
send;
A large smooth round Table make, write down the
Christ-Cross-Row.
In order on the Verge thereof, and then bestow
The Needle in the midst which touch't the Load, that
for
What note soe're you list it straight may turn unto:
Then frame another Orbe in all respects like this,
Describe the Edge, and lay the steel thereon likewise,
The steel that from the self same Magnes motion
drew;
This Orbe send with thy Friend what time he bids
adew:
But on the days agree first, when you mean to prove
If the steel stir, and to what Letters it doth move.
This done, if with thy Friend thou closely would'st
advise,
Who in a Countrey of far distant from thee lies,
Take thou the Orbe and Steel which on the Orbe
was set,
The Christ-cross on the edge thou seest in order
writ,
What notes will frame thy words, to them direct thy
steel,
And it sometime to this, sometime to that note wheele,
Turning it round about as often till you find
You have compounded all the meaning of your mind:
Thy Friend that dwells far off, O strange! doth
plainly see
The Steel to stir, though it by no man stired be,

Rum

Runing now heve, now there: He conscious of the Plot,
As the steel guides pinsnot, and Reades from note to note;
Then gathering into words those notes, he clearly sees
What's needful to be done, the Needle Truchman is:
Now when the steel doth cease its motion; if thy Friend
Think it convenient answer back to send,
The same course he may take, and with his Needle write,
Touching the several notes, what so he list indite.
Would God, Men would be pleased to put this course in ure,
These Letters would arrive more speedily and sure:
Nor Rivers would them stop, nor Thieves them intercept;
Princes with their own hands their business might effect:
We Scribes from Black Sea scaped, at length with hearty Wills,
At the Altar of the Load would consecrate our Quills.

Of this devise, how two absent Friends might confer at a great distance, *Wither* in his Annotation upon *V. Livius*, speaketh somewhat in the 32 Col. of his first Volumne; as namely, that a Letter might be Read through a stone Wall of three foot thick, by guiding and moving the Needle of a Compass over the Letters of an Alphabet, written in the Circumference. But the certainty of this conclusion I leave to the experiment of such as please to make tryal of it; but to pursue our present design, There is not any one errour that breedeth a greater confusion in Magnetical Know-

ledge,

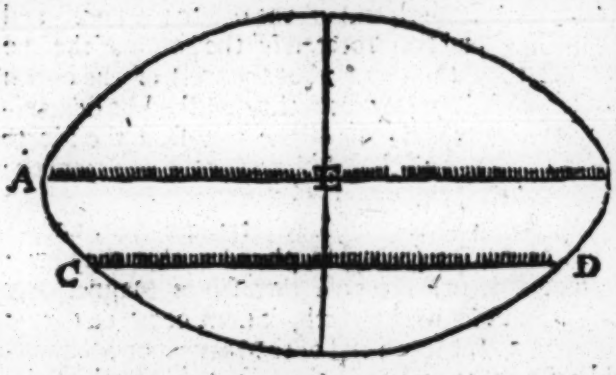
ledge, then the mistaking of the right understanding of the true North and South ends, as well in Magnets themselves, as also in Magnetical Bodies; whosoever therefore will take a little pains to understand this well shall free himself from many intricate difficulties in this argument, which otherwise must needs befall him wherein some having Limed themselves, have fallen into many errours, every one still begetting another worse than himself. All those which Write before Doctor *Gilbert* did name that end of a Magnet which being placed in a Wooden Dish, and set to swim in Water, would turn and settle it self (as we have said towards the North, the North end of the Magnet and the other the South end. And even so did they call all Dyal Needles, Compasses and Magnetical Bodies. But Doctor *Gilbert* not for any new fangled innovation or self conceit, but upon good reason and firm demonstration, avoucheth and proveth the contrary, and clearly sheweth, that the former vulgar assertion seriously defended, tendeth to the overthrow of all Magnetical Phylosophy, by undermining of (as it were) the whole frame thereof; and yet in common speech the old Rule may hold *Loquendum cum vulgo sentiendum cum sapientibus.* For it would seem a strange speech to a Marriner to tell him that his Flower de Luce were become the South point of the Compass, and yet this assertion is most true and certainly that it is the North end of every Magnet and Magnetical Body, that being placed in a thin Wooden Dish in Water, or any Magnetical Needle upon his Pin, which seteth it self and pointeth to the South, and it is the South end which pointeth to the North. For proof hereof, take these words of North and South in whether of the two former significations you please, and make tryal thereof in any two Magnets, or any two Magnetical Bodies, so placed that they may freely turn according to their natures, and you shall always see a natural inclination of the

contrary

contrary ends of the one to the contrary ends of the other, as of the South end of the one to the South end of the other, and reciprocated of the South of the one to the North of the other; but the ends of the one in the other will always fly from those of the like denomination, as the North end of the one from the North end of the other, and the South end of the one from the South end of the other.

For as much then as all Magnets themselve, and all Magnetical Bodies (being so placed as that they have their free motion) compose themselves Magnetically towards the Poles of the Earth, it must needs be that it is the true natural South end of the Magnet or Magnetical Needle, that pointeth towards the North of the Earth: And it is the true natural North end of the Magnet or Magnetical Needle that pointeth towards the South of the Earth, because the contrary ends do affect one another, and each of them do naturally fly, the one end of the one, from the end of the other, which is of like denomination unto it self; for Example, in this following Diagram of the whole Magnet, *E A.* is supposed to note the true natural North end thereof, and *B.* the South end.

This



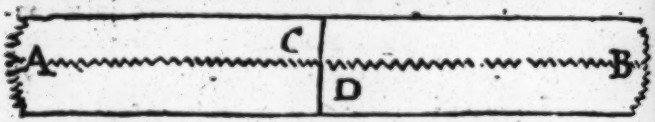
This Magnet being placed in a Wooden Dish, swimming in Water, freely must, and will, of Magnetical necessity, with his true North end, *A.* settle himself so, that *A.* must point towards the South of the Earth; and the South end, *B.* towards the North of the Earth, because all Magnets and Magnetical Bodies do naturally affect, the one the contrary end of the other, and do avoid and fly from their ends of denomination.

Now for a further consideration of these properties, suppose that you will cut a piece of this Magnet Meridionally, *viz.* *C D.* manifest experience will shew, that *C.* which did in nature participate with *A.* in the intire Magnet. *E.* as being both of the true North part thereof, now being seperate will not abide it. In like manner *D.* of the other end of the little one, will not abide *B.* of the great one, with whom being intire in nature, he did participate, as being both the Southerly parts of thr entire Magnet, *E*, and that because the ends of like denomination of any two Magnets, do naturtlly fly the one from the other.

But here you must be ware of an errour, which some have unhappily entangled themselves with all: who beholding of the aforementioned discord (as betwoen *A.* and

and *C.*) wrongfully ſuppoſed, that if both theſe Magnets, the greater and the leſſer, were conveniently placed to ſwim in the Water, the little one would not with his end *C.* point unto the South of the Earth, as it did in the Magnet, being entire; where it was a part of the true North end, but would point quite contrary. There is no manner of any ſuch alteration, but that both of the great one and the little one) and all alike, that are cut Meridionally one from the other) will abſolutely point the very ſame way which the entire one did in each of them from the diviſion, as you may gueſs by the two pricked Lines, paralell to the Meridian (or Axis) *A. B.* of *E.* the entire one, and the diſagreeing of theſe ends is only within the Orbe of their Forces, both their general poſitions towards the Earth ever continuing one, and the diſagreeing of their ends is only within the Orbe of their own forces, and they will (with very little help or none at all) conform themſelves in ſuch ſort, that the one end of them will joyn it ſelf end-long unto the other, at their contrary ends, and point the ſame way both of them, the which they did at the firſt in the entire one. If you touch the end of any Magnetical Needle upon *A*, being the true North end of the Magnet, the end of the Needle will become a true South end, and will point unto the North of the Horizon: if you touch it upon *B*, that will become a true North end, and will point unto the South of the Horizon. And the like will it do if you touch it upon *C*, as when you touch upon *A*: and upon *D*, as when you touch it upon *B*, although in both theſe not ſo ſtrongly; ſo that Doctor *Gilberts* aſſertion doth not gain-ſay the Mariners opinion, that his Flower de Luce ſhould not ſtill remain the North point of his Compaſs, only he ſheweth which end of the Magnet it is, which doth give him that Virtue; namely, that it is the true North end: ſo that if you hold the true North end of the Magnet

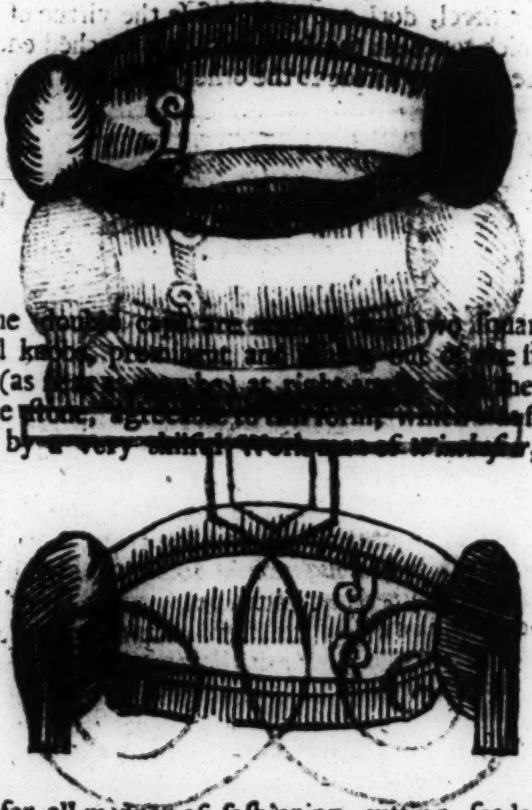
near unto the Flower de Luce, it will come unto him; if you take away the Magnet, it will come unto the North of the Horizon. If you will divide a Magnet not Meridionally as in the former Example, but



æquinoctial, as in this by the picked Line, *C. D. A.* being ſtill the true North end, and *B.* the true South end, and *A. B.* being the Meridian Line, or Axis of the ſtone: if you ſet theſe divided ſeveral pieces aſſunder, that they may ſwim within the Orbe of their forces, they will affect to joyn themſelves in the very place where they were divided, as alſo in the ends, *A.* unto *B.* by the former reaſon of contrary denomination. And if you place them a ſwiming without the Orbe of their Forces, *A.* and *B.* will ſtill yet retain their former natures; and even ſo will it fall out, if you make your diviſion in any other place of the Magnet, towards either end paralell unto the Equinoctial of the Magnet.

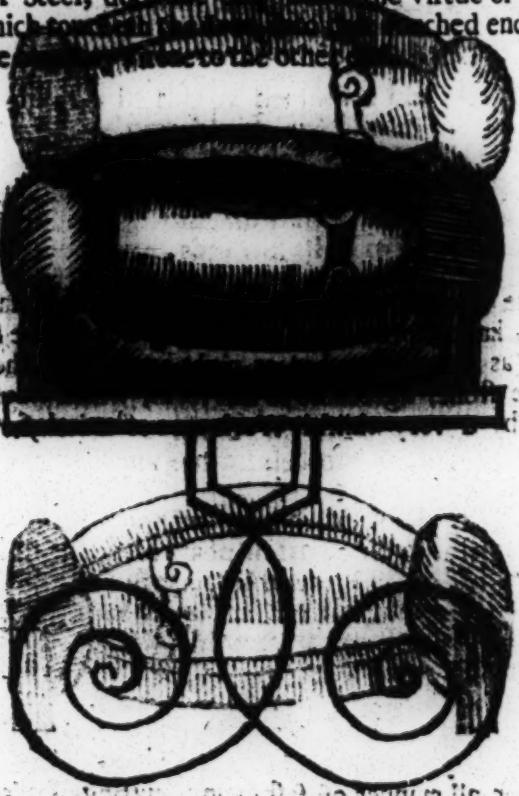
The ſtone being brought to his perfect form, you muſt have a mould made of Iron, of the ſame proportion in every reſpect, and equal in all his dimenſions, then ſetting your ſtone aſide, let your Work-man frame and faſſion his caps, and fit them upon his mould as if it were the ſtone; thus ſhall you be ſure to preſerve your Magnets from many dangers, very incident to rude handling; and having ſo done you may ſet them on the ſtone it ſelf, amending any ſmall faults without indangering the ſtone, either with bruiſings or knocks; for the thickneſs and largneſs of the caps, there can be no general rule preſcribed, but it muſt be left to the tryal and ingenious diſcretion and dexterity of the Work-man; as alſo for the handſome faſtening either by Soldering

dering or Revering of them with Latin plates to the caps, to keep them in their places, fast and firm and steady, according as you see in the picture of a ſtone armed with ſingle caps.



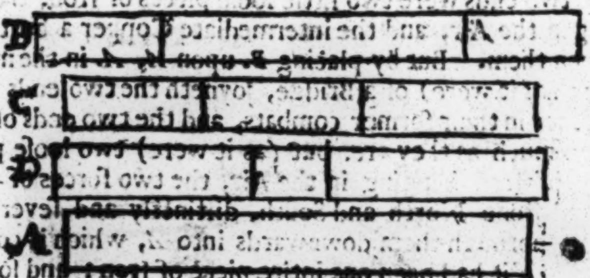
The [illegible] two ſquare or round [illegible] ſingle caps (as [illegible] the Axis of the [illegible] faſhioned by [illegible], one that for all manner of faſhioning, cutting, ſoadering, peecing, and capping of Load-ſtones, was the moſt exquiſite that I have known. I find that the uſe of the double capping is chiefly for admiration, in taking up a greater quantity, more by the one half than the two

several ends could do each by it self; as if each end will take up half a pound, being carried in this manner, that each prominent end may lay hold upon the Iron fitted in this manner, it ought to take up a pound and a half and more: the reason whereof is this, because the Magnet in touching any one end of a fitting piece of Iron or Steel, doth [illegible] of the virtue of that end which [illegible]ched end, but also the [illegible]



Now therefore in this position, both ends of the Magnet being applyed unto the two ends of the Iron, these two contrary forces strive in this piece of Iron, the

the North to repell the South, and the South the North; so that each force is driven nearer his own end, and becometh there so much the stronger then otherwise it would be. For proof whereof, take a little narrow square piece of Iron, of the length of the capped stone, and joyn it in the midst with Copper after this manner.



A. is supposed to be a long square, or a square like piece of Iron, in length fitting the two double caps of a Load-stone.

B. a long square piece, the ends Iron, the middle Copper, and D. least of all.

If you apply the Load-stone unto A. he will hold A. very strongly; but if you put any of the other three pieces under it, that it may touch any of them, he will not by any means lift it up. If you apply the Load-stone unto B, he will take it up very weakly, and C. somewhat more strongly, but D. strongest of all these three, yet not comparable to the strength wherewith he taketh up A. Again, although the Load-stone take up B. but weakly, yet if you place B. upon A, he will take them up both very strongly; yea more, place B. upon C, the two upon D, all three upon A, apply the Load-stone upon B, being the uppermost, and he will lift them all up very easily.

The cauſe thereof is, when a Load-ſtone with his double cap is placed upon *A*, the force of both ends ſtriving in that piece of Iron paralellwiſe unto the Axis of the ſtone, the North and South forces are driven more cloſely unto their proper ends. But *B*, (becauſe of the immediate Copper) there cannot be no ſuch cloſe driving of his forces unto their proper ends, as was in *A*: and therefore the Load-ſtone lifteth up *B*. but only as if his two ends were two little looſe pieces of Iron, hanging in the Air, and the intermediate Copper a burthen upon them. But by placing *B*. upon *A*, *A*. in the manner (as it were) of a Bridge, joyneth the two ends together in their former combats, and the two ends of *B*. foraſmuch as they are, but (as it were) two looſe pieces of Iron hanging in the Air, the two forces of the Load-ſtone North and South, diſtinctly and ſeverally paſs through them downwards into *A*, which it could not do if it had been one intire piece of Iron: and ſo all thoſe four pieces, being placed one upon another, ſo that *A*. be undermoſt, whether directly or ſide-ways, the Load-ſtone will eaſily lift them all up, and not otherwiſe.

When a Load-ſtone lifteth up Iron at one end only, the virtue of a ſtone is infuſed into the whole body downward of that Iron, if it be not very long.

But when by means of the double caps, both ends do lift Iron joyntly together, he infuſeth very ſmall force downwards into the body of the Iron that it lifteth up: for the forces of both ends are ſo ſtriving in the Collateral Line of the Iron, paralell to the Axis of the ſtone, that whereas a good Magnet lifting up at one end, will extend his virtue downwards twelve or fourteen Inches, in applying both ends unto the Iron by the means of the double caps, he will not extend his force downwards the diſtance of one Inch, nor with any ſtrength the diſtance of half an Inch, as in this former Example.

If

If a Magnet will lift at one end a pound of Iron, faſten you half an ounce of Iron unto four ounces of Wood, or any other ſubſtance ſaving Iron, and he will never take it up, becauſe his virtue can only pierce that half ounce, and hath no power to enter the other ſubſtance; and that ſmall portion of virtue, contained in the half ounce, cannot hold up the other ſtrange ſubſtance. But this very ſame Magnet, by the means of double caps, laying hold of a piece of Iron fitted for that purpoſe, and of the faſhion, being but half an ounce, may very well and readily take up three pounds of any

other ſubſtance whatſoever that is faſtned unto it, becauſe that the whole force of the ſtone being imployed in the ſtriſe of the contrary ends, in the Iron paralellwiſe, unto the Axis of the ſtone, each end apprehendeth and lifteth up this piece of Iron and a great portion of any other ſubſtance that is faſtened to it, and his whole force being imployed herein, all his former vigour, upward, downward, end-long, is (as it were) fettered and impriſoned, that untill you looſe him of

these fetters, he is not able at one end to take up one quarter of that which he did before.

Pliny in his natural History writeth, that *Dinocrates* that Famous Architect Builder of *Alexandria*, at *Ptolemies* command began to vault a Temple with Magnets, that there might seem to hang in the Air the Image of his Sister *Arsinoe*, made of Iron for that purpose: but both *Dinocrates* and *Ptolomie* dying in the mean space, that enterprise ceased. Neither indeed (if the both had lived) could it ever have come to pass by that means, by reason of two impossibilities: the one is, that by the force of the Load-stones, nothing can so hang in the Air, but that it either must touch the stone it self, or some other intermediate substance between it and the stone, that bareth it from coming to the stone it self. For Example, lay two or three Needles upon a smooth Table, put a Silver or Pewter Plate upon them, and upon that Plate a Load-stone, then lift up the Plate aloft with the Load-stone lying still upon it, and you shall see the Needles hanging indeed in the Air endlong, and if you move the stone about the Plate, following still underneath, but evermore touching the Plate, which is the intermediate body, which keepeth them from coming to touch the stone, which otherwise by their natural inclination very speedily they would do. But as for the Image of *Arsinoe*, how had it been possible for it to have toucht at once, mediately or immediately, so great a number of Load-stones, whereof the pretended Vault must needs have consisted? the other is, that such a multitude of Magnets would nothing but confound the one the others forces, so that one of them alone being solitary and severed from his company, might shew more force than all the associable society could do, each one hindering the efficacie of the other. Much like a Team of many Horses, where every one drawing his several way, might soon with disordered stretching tire himself and his fellows, but never

never move the Load one jote from the place. Insomuch as one (and possibly the worst) would do more good alone, where he might orderly and freely use his own strength, then he and all the many of them could do, being joyned together in vicinitie of bodies, but extreamly distracted through contrarity of courses.

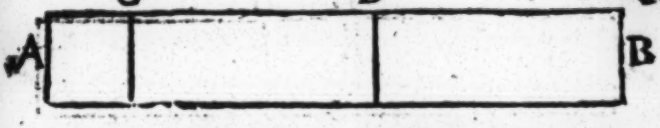
The only way to perform such a design (if it were worth the doing) would be to prepare one mighty great Load-stone of excellent goodness, which having his due proportion, after an extended Ovall form, should be fitted with double caps, and so placed in the Roof of a Building, that his Axis be paralell to the Horizon: in this manner (out of all doubt) a fair large Image might be held up very strongly by such a Magnet, let the stuff or substance thereof be whatsoever (howbeit the lighter the better) so that there be fastened to the uppermost part of the Image a small piece of Iron, according prepared and placed for the two prominent ends of the double caps of the stone, to lay hold thereon. But enough hereof.

In the caping of the Magnets, this general rule is to be observed, that they ought to be made of the finest and softest Iron, and not of Steel: the weight also, which the Magnet taketh up, should be of the like Iron, and not of Steel (as aforesaid) for although Steel at the least retaineth Ten times as much virtue as Iron, when it is once seperated from the stone, can doe; yet as long as there is any contignity between the stone and them, he holdeth Iron more stronger than Steel. Both which differences in either of them, by manifest experience are certain, and seem to proceed from notable fastness and closeness in the Steel above the Iron; by means whereof the Magnetical Virtue doth longer and more forcibly continue in that than this: even as fire more mightily possesseth, and for a greater space abideth in stone, or any such firm or solid matter, then

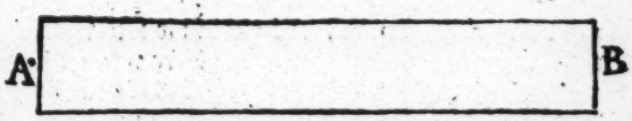
in Wood or Straw, or the like thin and hollow ſubſtance; and therefore thoſe Compaſs makers, that make the Wiers of their Flies for Sailing Compaſſes of meer Iron, ought not by any means to be ſuffered; for to gain Two-pence in a Compas (and ſcarcely that) they intollerably abuſe thoſe that Travel by Sea, to their great danger and miſchief.

To cement and piece Load-ſtones, for your Simmon doe thus: take the fine powder of Load-ſtone, half ſo much powder of New-brick made very ſmall and ſubtill, one part of Burgundy-pitch, half ſo much of Roſſen, a ſmall portion of unwrought Wax: mingle all theſe together very well upon a ſoft Fire, and make the whole Maſs in little Roules. Now when you will cement a ſtone, do thus: heat the two pieces of the ſtone very hot, and likewiſe the Simmon, then ſtrake the places as you will ſoder, over with the Simmon very thinly, and joyn them ſomewhat hard together, letting them ſo ſtand untill they be cold, and you ſhall have it fully as ſtrong, as if it were an intire ſtone it ſelf, and not to be ſevered by great heat of Fire. In piecing of the Load-ſtones, there muſt be great care taken to the nature of the Load-ſtone in general, and alſo to thoſe particular pieces which you would joyn together. The Load-ſtone in general (as it is ſhewed before) that his force iſſueth (as it were) from a center in the middle of the ſtone, to all the ſuperficies whereof univerſally, but moſt ſtrongly unto the Poles from the middle, one way the ſtone is all of a Northly nature, and all of it Southly the other way. For Example.

A. is



A. is the North end, *B.* the South end of a ſtone, *D.* the middle. Suppoſe you cut off a piece at *C*, then ſhall *D.* be no more the middle, but it ſhall be a part of the North of the ſtone, and the middle is removed nearer *B*, and the virtue of the North and South doth not now divide it ſelf at *D.* (as it did before) but *D.* is now become a part of the North end of the ſtone, which it was before in this Example following, let there be two Load-ſtones, the one longer than the other,

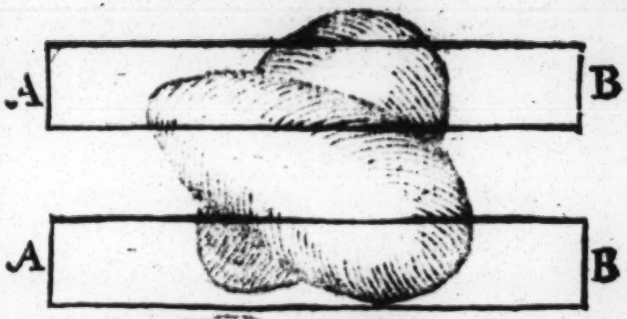


the North of both noted with *A*, the South with *B.* the middle of the ſhorter, where the North and South properties doe part, is *C.* Suppoſe you will faſten theſe two with Simmon, the end *B.* of the ſhorter unto the end *A.* of the longer, ſo ſhall theſe two become one Load-ſtone, and not one *C*, which was the middle (where the North and South properties did part) in the little one, is now become a part in the North end in this conjoyned ſtone, but alſo even *B.* it ſelf, which

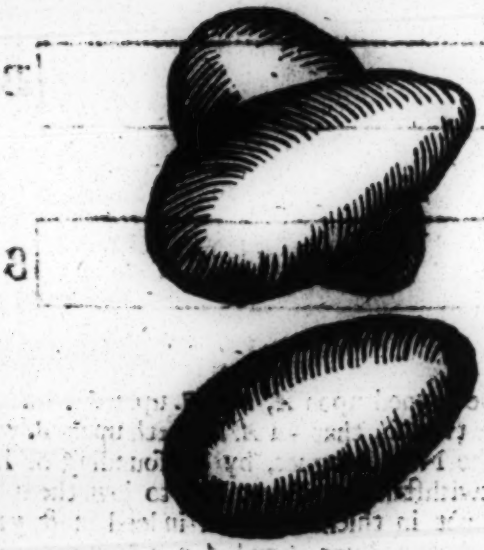
was

was in the ſhort one the very South Pole, is now in this become part of the North portion; the middle of this (where South and North properties do part) being in *E*. and theſe two Magnets which had each of them two points, the one North and the other South, being joyned together, have but only two points in all, the one North and the other South. Moreover if you have two Load-ſtones (for example) of like goodneſs, about four Inches a piece in length, having their North and South points duly at their ends, if you cut off at either of their ends half an Inch, and conjoyn them with the contrary of the great ones, they will preſently have contrary properties to that which they had before; ſo that a Needle touched before that would turn North, being now toucht in the ſelf ſame place will turn South, ſhewing that the virtue of the two ends doth always proceed and extend it ſelf from the body of the whole Load-ſtone, and from the whole, ſheweth it ſelf moſt forcibly (as aforeſaid) in the ends; and either of the Load-ſtones will be in his perfect goodneſs, as at the firſt. If you think good to ſet two Load-ſtones together in ſuch a manner, that you will have the Augmentation only in thickneſs and not in length, then do thus: if they be both of one length, grind them ſo that they may joyn cloſe, the broad-ſide of the one, agreeable with the broad-ſide of the other, having North upon North, and South upon South, as in this Example.

A. muſt



A. muſt be ſigned upon *A*, [illegible] upon *B*: but if you joyn the two ſo, that an *A.* [illegible]th upon *B.* you may ſpoyl the N[illegible]net, by confounding of his forces. Notwithſta[illegible] to joyn them in length only, not in th[illegible] indeed muſt you combine *B.* and *A*, and not *A.* and *A*, nor *B.* and *B*, leaſt here alſo you incur the former inconveniencies of confuſion of forces. To take another example: ſuppoſe a Magnet to be long and ſomewhat round, ſmaller at one end than at the other, the ſmaller end to be the North ſigned with *A*, the other South ſigned with *B*; let the Magnet be divided long-ways into two equal parts, thorow both the Poles *A.* and *B*, and let one of theſe halfs be placed upon a piece of Glaſs or a ſmooth Table;



Table; certain it is, that if you do offer to touch *A.* of this, with *A.* of the other, this *A.* will turn away from that, which (the ſtone being entire) it did joyn with before: or if you offer *B.* unto *B.* it will do the like. And no marvel, for in the caſe of touching *A.* with *A.* or *B.* with *B.* what elſe in effect do you, but intend to joyn the two halfs at length, and that at like ends? a thing directly repugnant to the principles of Magnetical Phyloſophy. But let me admoniſh you, to put the rounder ſide of the ſtone downwards, next unto the Glaſs, that it may turn the quicker: yet if the ſtone be excellent it will do the ſame alſo upon the flat ſide. Moreover if you place theſe two halfs, the one upon the other preciſely as they were at the firſt, they will agree very well, becauſe they are as one and the ſelf ſame Magnet. But if you place them the one ſwarning from the

he other at either end, then will *A*, of the one, turn bout to *B*, of the other; becauſe they are now as two veral and diverſe Magnets. For the better conceiving eroof, you are to remember, that every part of a oad-ſtone (being a half or any other) being once di-ided from the whole, is (as Schoolmen call it) *totum integrale*, a whole Load-ſtone by it ſelf, utterly diverſe nd eſtranged from that whole, whoſe part before it as, and therefore retaineth diſtinctly in it ſelf, all the properties of a Load-ſtone, though not ſo ſtrongly as the whole had, when as it was joyned thereunto.

In Load-ſtones there is a part truly ſaid to be divided from the whole, when the points of that part or ends, or Poles, and ſo, by neceſſary conſequence, the Axis and Æquator, in which the univerſal frame of Magnetical power conſiſteth, have a poſition diverſe from the Poles or points of the World. For this cauſe, in the laſt example the one half *A*, *B* being ſuppoſed to ſwarve from the other half *B*, *A*, at either end, muſt needs preſently be divided from it, and now cannot be *pars integri*, but is of neceſſity *totum integrale*, a ſeveral and abſolute Magnet of it ſelf, and ſo by an eſſential property common to all Magnets, coveteth with his point *A*. the contrary *B*. of that which is under it. Wherefore like as exact agreement is between two Mathematical Figures, when being applyed together, the extreams of the one, do preciſely fall upon the extreams of the other, each upon his correſpondent extream, and it is made one therewith: even ſuch is the perfect compoſition or ſetting together the parts of a Magnetical Body, and namely of thoſe two equal parts before exemplifyed, you muſt ſo joyn one upon another, that the two extreams or ends be always of the ſame nature Northly or Southly, in both parts; and that by the due application of the parts, the two Northly ends being united and become one, as alſo the two Southly after the ſame manner. But if theſe parts, being of equal

length,

length, be joyned lengwise, the North of the one unto the South of the other; those two ends that were (being now no ends, but the just middle of one Magnet) have lost their properties which they had when they were ends. For those properties, by this Union are abolished, but their other ends still reserve their former and stronger virtues of North and South; and so according to Magnetical nature, one Magnet shall have but two Poles, the North and the South. Again, if you will piece two Load-stones together in thickness, the one of them being longer than the other; then you must either cut the longer that it may be fit in length unto the shorter, or else piece the shorter in such a manner as is before described, that he be equal in length to the longer, and whatsoever dilomerly parts perhaps shall be in any of them, they may, even after they are cemented, very well be ground away. Also if there be holes or dents, with little pieces of Load-stones cemented (their points being observed) they may be filled up, without any manner of damage or deformity, no more then if there had not been any such at all. And after this Method you may (with labour and industry) of many Magnets, make one huge, and of what form you please. And although the Magnets of this body, Magnetically compact (as I have here shewed) were never so many in number, yet the whole will have but two principal points, the one the North, the other the South, even as if it were one natural Load-stone, and all of them will contribute their forces unto these two points; so that if there were twenty of them, being after this order cemented together into one body, the whole would have but two points, but if you will place them in a Vault, according to a Masons Trade, they will have 40 points, twenty North, and as many South, and will work the like effect in drawing Iron, as (to use the former gross similitude) if a Teeme of Horses were set in their Traces contrary the one to the other,

the

the one to pull one way and the other another. As for the Turks Mahomet hanging in the Air with his Iron Cheſt, it is a moſt groſs untruth, and utterly impoſſible it is for any thing to hang ſo in the Air by any Magneticall power, but that either it muſt touch the ſtone it ſelf, or elſe (as we have ſaid) ſome intermediate body, that hindereth it from coming to the ſtone, or elſe ſome ſtay below to keep it from aſcending, as ſome ſmall Wyer that can ſcarcely be ſeen or perceived.

The manner to know the one Pole from the other, which of the two points aforeſaid may anſwer to the Pole Artike or the North Pole, is found in this manner

a lagre

a large Veſſel is to be filled with Water, in the which cauſe the ſtone Magnes to be laid upon a light Board, not deep, much like the covering of a Box, ſo nevertheleſs that the two points found in the ſtone may lye equally elevate in the ſaid Box; and ſo by virtue of the ſtone, the Box ſhall be moved to the place where the Meridional Pole ſhall exceed towards the South, and the other oppoſite to the North and ſhall reſt there, and thus ſhall it be eaſie to diſcern, which of the Points anſwereth to the Pole Articke, and to the Pole Antartike, ſo that any means firſt the places of Heaven be known.

Conterning the Magnetical force of the whole body of the Earth, I have ſelected theſe experiments to prove it.

Take any piece of ſolid Earth that hath ſome toughneſs to hold together, and will abide the fire, as any ſort of Clay or Brick (which ſometimes was Clay faſhioned) it in ſuch manner that it be uniformly extended towards both ends (the Oval or Long Figure is fitteſt for our purpoſe) put it into a Fire of Charcoales, increaſing the heat by little and little, and at the length with often blowing, make it as throughly red hot as you can; let it remain ſo for the ſpace of half an hour or more, that thereby all the ſuperfluous moiſture may be conſumed, and adverſe qualities ſeperated from it, then take it out, and let it cool: it half being firſt ſet North and South, with either end anſwerable to the variation of the place, not paralell to the Horizon, but elevated anſwerable to the Latitude as near as you can. Certain it is that this piece of Earth thus ordered, will ſenſibly ſhew you that it hath true Magnetical Virtue. But here before I proceed any farther, I muſt deliver unto you a neceſſary obſervation. There are two ſorts of Attractions (as they are commonly called) the one Magnetical, the other Electrical. The Magnetical hath always a ſpecial reſpect to the North and South

points

points (as we have often said) of the Magnet or Magnetical Body. The Electrical Body hath no manner of respect to any one point of the Electrical Body, more than another: and by this difference these two kinds of Attractions are easily discerned, as also by this, look what end of the Magnetical Needle the one end of the Magnet doth draw, the other will chase away; but the Electrical Body draweth alike at all ends. And Thirdly after this manner, lap this Electrical Body in a Paper and it will draw nothing to it at all, but interposition of Brass or a stone Wall within the Orbe of the Magnets virtue, doth nothing weaken the same, or hinder his effect towards his peculiar object. Notwithstanding (to speak properly) Attraction appertaineth only to Electrical Bodies, because the whole Attractive virtue is only in the Electrical Body it self, and nothing as in the thing that is attracted. The Attraction (commonly so called) of the Load-stone is rightly to be termed, *Coaptation*, *Conjunction*, or *Coition*, because it is the running or vigorous meeting together of two Magnetical Bodies, having a mutual Inclination the one with the other, or by any other name, bearing the like sense. For the true knowledge thereof, being but lately as a stranger arrived amongst us, for common use,

(*Quem penes arbitrium est, & jus & Norma loquendi*,) hath as yet scant suited it with a convenient Name to express this property; so that Magnetical Conjunction is never but between two Bodies, such as both of them are Magnetical; as of one Load-stone with another, or of a Load-stone with Iron or Steel, or Iron Oare if it be prepared, or between two pieces of Iron or Steel that are Revived with a Load-stone; for indeed the Load-stone can but revive and multiply Magnetical force in a Body that naturally hath it in some measure before: but cannot infuse it into any thing, that before is utterly void of it, as of Mettalls in Iron and Steel, and not in Gold, Silver, Brass, &c. Electrum

Electrum in this Argument is named that which is either Amber in substance, or at least of the quality, and that Amber-quality hath an attraction to take up Straws, Feathers, Leaves, and other small things, the which property is not in Jeat, Brimstone, Hard-wax (if it be smooth) and in many other things, both natural and compound, all which because of that quality in this Argument are termed Electrical Bodies, and their taking up of things is called Electrical Attraction, having only a slender resemblance, but no truth of the Magnetical Quality.

But that above mentioned piece of Earth, prepared in such a manner as is before prescribed, will by Magnetical Concretion shew it self to be a true Magnetical Body. For the one end of the Magnetical Needle will covet towards the one of the prepared Mass, and flye from the other. And contrary-wise also, though it will do both but weakly, not with power comparable to a natural Load-stone, yet as truly as that. That end which cooled towards the South, will draw the true North end of the Needle, and that end which cooled towards the North will draw the true South end of the Needle. If so be that as yet you will have another infallible Argument, do thus; mark what end draweth the North end of the Needle, afterwards put the new made Magnet into the fire again, and when it hath been glowing for the space of half a quarter of an hour, take it out and cool it, being placed with that marked towards the North, most assuredly that end now will draw the South end of the Needle, and the North end of the Needle will shun it, which before approached unto it, the reason hereof is, because the first having abolished all the former Magnetical quality of that Mass wherewith it was in a contrary position affected in the former cooling, now leaving it apt and fit to receive any new Impression: which presently it taketh again either regularly, if in the cooling it be placed with the

ends

ends to the North and South, or (if it be placed otherwise) confusedly, by the Magnetical force and virtue of the whole body of the Earth, by regular and confused, this is the meaning. Take any lump of Earth, or any Brick-bat ordered in this manner, certain it is that this lump of Earth or Brick-bat hath some Magnetical virtue therein, yet so feeble and weak, that our sence cannot discern it, because of the unfitness of the form, and the confused dispersion of that weak force, through the whole body thereof. Then suppose you will bring either of these into an extended Ovall form, which is apt (as before I have said) for any body Magnetical to shew his force; yet this will help it nothing at all of it self, as you may easily make experience in every Load-stone. For if you take a Load-stone of a confused form, it is not enough to bring it into a convenient Ovall, except with diligence you reserve the points of the North and South in the two ends thereof, for if you leave the points in the sides, you spoile it with this Ovall form. For the stone will not lightly be of one quarter of the force, as it was before; for the Ovall form giveth it no virtue, but it is the fittest for it to shew the uttermost of that strength, which of it self it had before, if you observe the due points, and not otherwise. But in this Earth and Brick it is not possible to find the due points in such a manner as you may in a Load-stone, because of the weakness of the Magnetical force therein contained. And therefore you cannot bring that into a regular Ovall form, and by the Fire take away the confused Magnetical force, and all other perverse qualities thereof, that being by nature a Magnetical body in his cooling before specified, receiving presently by that unresistable power of the Earth, his Magnetical virtue, according unto that form, and will regularly have his due points precisely in the ends, without any confusion. *Johannes Baptista Porta* writes, that he did make tryal of the way that *Paracelsus* hath set down for to increase

the

the virtue of a Magnet; Namely, to heat him red hot in the Fire, and to quench him in the Oyl of *Crocus Martis*: and *Baptista Porta* saith, that he found it a detestable priesthood. But saith he, he is so far from increasing his virtue, as that (being once red hot) he looseth all his own, past all recovery. But for all this that he saith, I doubt whether *Paracelsus* be justly reproved or not, for by my own experience I know that the heating of a Load-stone untill it be red hot, doth weaken a Load-stone, but taketh not away all its force; and in my tryal hereof, I found a very manifest proof of the Magnetisme of the Earth, which I thought necessary to insert in this place. I have made this tryal of fragments of Magnets in divers kinds, and likewise of divers kinds of Iron Mines which are next in degree to the Magnets; Namely, after this manner, Heat him in the Fire by little and little (for fear of breaking) untill he be red hot, then take him out and let him cool, then mark (with Chalk or what you please) those parts that respect the North and South, and you shall find those markt places, the North and the South Poles of the Magnet. Put him into the fire again, untill he be red hot, and cool him contrarily, and you shall have the contrary effect. Therefore if *Baptista Porta* did make his tryal with a Load-stone very long in form, and chanced (for Doctor *Gilberts* mistery of the Magnetisme was not then revealed) for to cool him in his Oyl of *Crocus Martis* with his ends East and West, the Axis of the stone being then overthwart in the middle, it were no marvel, though it found no force in the ends. And I doe not think it impossible, but that *Paracelsus* way may doe some good rightly used. Doctor *Gilbert* writeth, that some Iron Mine will affect a Magnetical Needle, as it is of it self, being unprepared by fire: but as yet I never could find any such, but this I have often tryed, that it being of no manner of Magnetical virtue of it self, no more then a Flint stone unprepared by fire,

fire, being made red hot and cooled, is presently impregnated with very apparent Magnetical virtue, according to the scituation that he is cooled in, and although you heat and cool him often, and divers ways, he will still keep his virtues, according to the situation of his cooling. And some Iron Mines I have found, which being but in this sort prepared, have had as strong force as some natural Magnets have had; it is the goodness of the Load-stone joyned with a fit form that will shew great force: For as a very good form with a base substance can doe but very little, so the substance of the Load-stone be it never so excellent, except it have some convenient form, is not availeable. For example, an excellent Load-stone of a pound weight and of a good fashion, being used artificially, may take up four pounds of Iron; beat it into small powder, and it shall be of no force to take up one ounce of Iron; yea I am very well assured, that half an ounce of a Load-stone of good fashion, and of like virtue, will take up more then a pound will doe being beaten in powder. Whence (to add to this by the way) it appeareth manifestly, that it is a great errour of those Physitians and Chirurgeons, which to remedy Ruptures, doe prescribe unto their Patients to take the powder of Load-stone inwardly, and the small filling of Iron inwardly: suppose here that the Magnetical drawing should do great wonders, whereas they consider not that the stone being dissolved into powder, every little particle of the dust hath two points contrary, the one drawing to, the other repelling and putting from; and so being thus confounded by a contrary working, doth much more harm then good with his Magnetical quality. As for the astringent and drying property of the Load-stone, I leave them to the diligent observation of those that are skilful in Physick: but to return to our purpose, and to alledge this also, besides the manifest proof, if the Earth were not by Nature a Magnetical body,

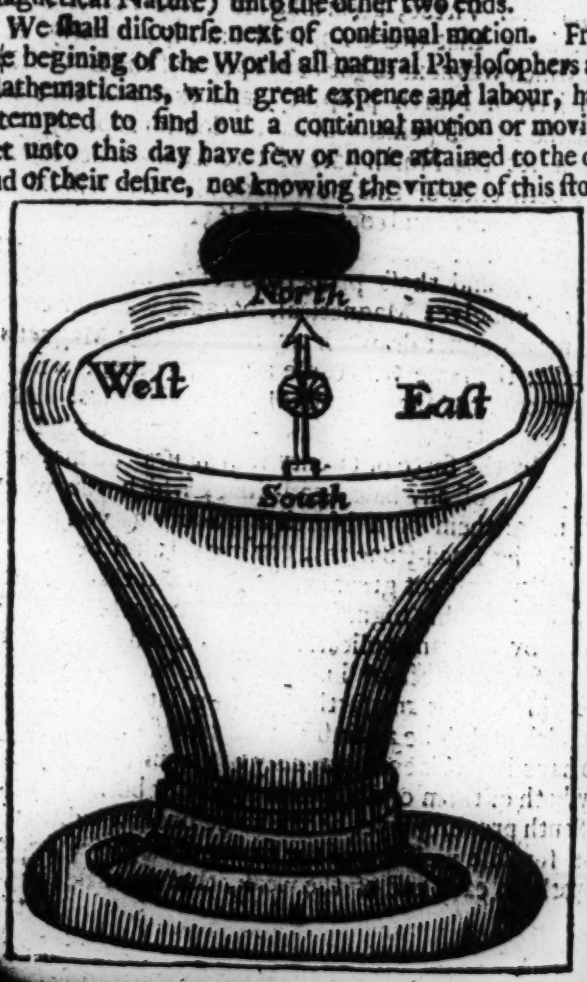
body, the aforesaid mentioned piece of Earth were not by Nature a Magnetical body, the afore mentioned piece of Earth could not receive from a Load-stone any Magnetical power: but most certain it is, and by many undoubted experiments confirmed, that it will evidently receive a Magnetical power from a Load-stone: therefore it is manifest that the Earth is by nature a Magnetical power: but most certain it is, and by many undoubted experiments confirmed, that it will evidently receive Magnetical power. From a Load-stone therefore it is manifest that the Earth is by nature a Magnetical body. Furthermore, as amongst all the Mettalls, Iron doth incomparably more resemble the Earth in substance then any other doth; it likewise doth participate more with the Earth in quality, and principally in the Magnetical peculiar property hereof, as notorious experience declareth; yea every piece of Iron Oare, being naturally (as Doctor *Gilbert* sheweth) a Magnet, although of feeble force, and all Magnets being a kind of an Iron Oare, is the very cause, that only Iron or Steel, and no other Mettall is capable of that virtue, Namely, to have that revived and multiplyed by the vicinity of a Magnet, which at the first in some measure was originally in it self, as it is aforesaid; it is also well known, that the Magnet is a stone most commonly of invincible hardness, nothing inferiour to any Iron or Steel of the excellentest sort; notwithstanding sometimes we see of them that are nothing, but a dry lump of Earth, and yet of those also some are stronger in virtue, than divers of the hard stones are: which Earthly Magnets, if a man assay to bring them into fashion by grinding on a Grinding-stone (according to the common use) they will consume into very Mud in the Water. Now (to draw towards an end of this matter) albeit that the Magnetical virtue be most eminent in the Magnet, as in the precise and perfect subject thereof: yet it is the self same quality, in a meaner degree, evidently to be

perceived

perceived in every piece of Earth, prepared and ordered (as is aforeſaid) yea, although it be not cooled with his ends North and South, that it may take its Magnetical force from the virtue of the Earth, for if you cool it with his ends but Eaſt and Weſt, and ſet two Load-ſtones in the cooling, the one at one end and the other at the other end, it will receive a ſenſible and apparant Magnetical Virtue, according to thoſe points of the Load-ſtone that were applyed unto it; namely, that end which was next to the South point of the Load-ſtone will have a North property, and that end that was next the North point, will have a South property; yea, if you ſet the North part of two Load-ſtones to each end, both ends of this new made Magnets will have a South property; and contrariwiſe if you apply the South ends of two Magnets, both his ends will have a North property; and thoſe properties before mentioned will ſhew themſelves Magnetical, becauſe whether end of this new Magnet draweth any one end of a Magnetical Needle, the ſame will cauſe away the other: which is proper only to Magnets and Magnetical Bodies. After the like ſort, only by application of two ſtrong Load-ſtones by the force of twenty four hours you may alter the points of any baſe Load-ſtone, which you would, and make them both North and South as you pleaſe: ſo that the Load-ſtone that you would alter be but baſe in quality, and not great in ſubſtance, and that the other be of a reaſonable bigneſs and good ſtrength. And this virtue by ſuch an application of two Load-ſtones I have often found effectual in new Brick lately taken from the Kill without any farther putting into the fire at all, and although it be againſt the nature of the Load-ſtone to have both his ends naturally of one virtue, that is to ſay both of them of a North property, or both of them of a South property; yet here is to be underſtood, that it is the forcible violence of the ſtrong ones, being applyed joyntly to each end of the weak, that do chaſe the contrary

trary property of the weak one into the middle thereof; and therefore if you divide this weak one in the middle, then both thoſe ends which being joyned together in the middle (where no Load-ſtone can ſhew any virtue) being now diſjoynted and become both ends, will preſently ſhew a contrary property (according to the Magnetical Nature) unto the other two ends.

We ſhall diſcourſe next of continual motion. From the begining of the World all natural Phyloſophers and Mathematicians, with great expence and labour, have attempted to find out a continual motion or moving, yet unto this day have few or none attained to the due end of their deſire, not knowing the virtue of this ſtone,



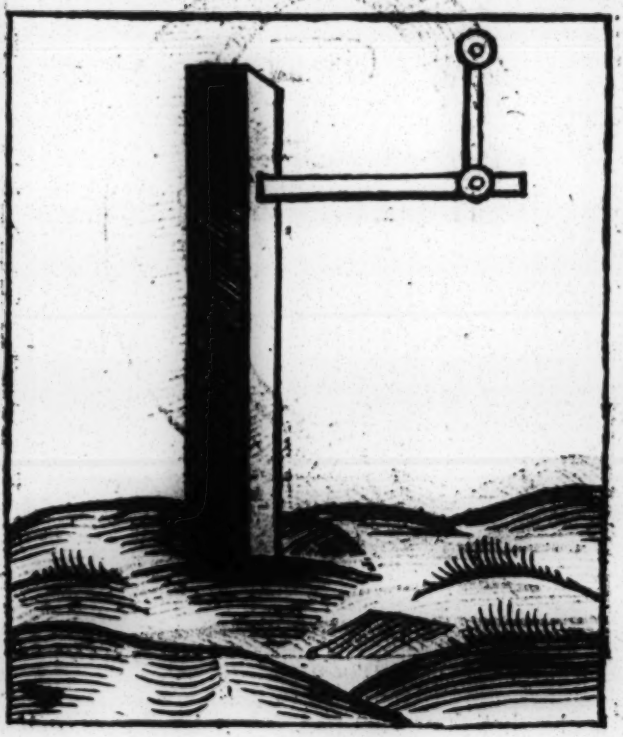
for there cannot be a continual motion found by any other means, then by the Magnet, in this manner, make a hollow case of Silver after the fashion of a concave Glass, outwardly laboured with the curious Art of Graving, not only for Ornament, but also for lightness, for the lighter that it is, so much the more easier it shall be moved, neither must it be so pierced through, that such as are ignorant of the hidden Secret may easily perceive it.

The form of the stone is Represented in this following Figure.

The Form of the Stone.

I muſt have on the inner ſide certain little Nailes and Denticles and ſmall Teeth of Iron of one equal weight, to be faſtened on the Border or Magnet, ſo that the one be no farther diſtant from the other, then is the thickneſs of a Bean. The ſaid Wheel alſo muſt be in all parts of equal weight, then faſten the Axletree in the middle, upon the which the Wheel may turn, the Axletree remaining altogether immoveable. To the which Axletree again ſhall be joyned a Pin of Silver faſtened to the ſame, and placed between the two caſes in the higheſt part, whereon place the Load-ſtone. Being thus prepared, let it be firſt brought to a round form; then (as is ſaid) let the Poles be found: then the Poles untouched, the two contrary ſides being between the two Poles, muſt be fyled and poliſhed, and the ſtone brought in a manner to the form of an Egg, and ſomewhat narrower on thoſe two ſides, leaſt the lower part thereof ſhould poſſeſs the inferiour place, that it may touch the Walls of the caſe like a little Wheel.

This



This done, place the ſtone upon the plain, as a ſtone is faſtened in a ring, with ſuch Art, that the North Pole may a little incline towards the Denticles, to the end, that the virtue thereof work not directly his impreſſion, but with a certain inclination give his influence upon, the Denticles of the Iron. Every Denticle thereof ſhall come to the North Pole, and when by force of the

Wheel it ſhall ſomewhat paſs that Pole, it ſhall come to the South, which ſhall drive it back again; whom then againſt the Pole Artick ſhall draw as appeareth. And that the Wheel may the ſooner do his office within the cafes, inclose therein a little *Calculus* (that is) a little round ſtone or pellet of Copper or Silver, of ſuch quantity, that it may commodiouſly be received within any of the Denticles; then, when the Wheels ſhall be raiſed, the pellet or round weight ſhall fall on the contrary part. And whereas the motion of the Wheel downwards

to

to the loweſt part, is perpetual, and the fall of the pellet, oppoſite or contrary, ever received within any two of the Denticles, the motion ſhall be perpetual, becauſe the weight of the wheel and pellet ever inclineth to the center of the Earth and loweſt place. Therefore when it ſhall permit the Denticles for to reſt about the ſtone, then ſhall it well ſerve to the purpoſe. The middle places within the Denticles ought ſo artificially to be made hollow, that they may aptly receive the falling pellet or plummet, as the Figure above declareth. Thus I have written as briefly as I could of the admirable and wonderful and incomparable virtues of the Loadſtone.

The Sea-mans Director, as well in diſtreſs of Weather, as alſo at his leaſure times of Recreation, how to make a right uſe of the Magnetical Needle, how to manage the Saying Compaſs, and the reſt of the Inſtruments of chiefeſt concernment in the Art of Navigation.

HAving already diſcourſed of the virtues of the Loadſtone, as we are very unwilling (for to divide ſuch dear friends) we next ſhall Treat of the Magnetical Needle.

The variation of the Magnetical Needle, being aptly fitted and placed upon his pin, is nothing elſe, but the ſwarving of the pointing of the ſame in the Horizon, from the *Meridian* line there, the portion of the Horizon intercepted between the true *Meridian* line and this pointing, ſheweth of what quantity the variation is, and giveth it his name, to wit, which way it lyeth, either Eaſterly or Weſterly, and it is obſerved by either end of the Needle as you pleaſe.

In times paſt men obſerved only by the North end of the Needle, becauſe they underſtood not that the Load-ſtone hath a South virtue, as well as a North; and therefore did touch their Needles and Wyars of their Compaſſes always for the North only, leaving thoſe ends of the Wyars bare, that they might be refreſhed with a new touch at any time afterwards: but the other ends they covered, not knowing that they were alſo apt to receive as forcible a virtue from the Load-ſtone for the South, as the other for the North. For the right underſtanding of the variation, which is neceſſary dependants, we muſt uſe the means of two circles, the one of them I will call the *Magnetical Almicanter*, the other is already known by the name of the *Magnetical Meridian*.

This *Magnetical Almicanter* is a circle parallel unto the Horizon, whoſe center is the Vertical point, and is deſcribed by the diſtance between the Vertical point and the nearer Pole of the Earth; the Magnetical reſpective pole, or (which is all one) the Pole of the Magnetical *Meridian*, is a point in the Magnetical *Almicanter*, as the variation of that place containeth in the Horizon, but always it is the contrary part of the true *Meridian*: that is, if the variation of the South part of the Needle be Eaſterly, the reſpective Pole is Weſterly: but if you obſerve with the North end of the Needle, the reſpective Pole and the variation are both one way in all our Northern Climates. If the variation of the South point of the Needle be Weſterly, then is the reſpective pole ſo many degrees in the ſaid *Almicanter Eaſterly*, and therefore always of the ſame height with the true Pole above the Horizon. For ſince all great circles of the Globe do neceſſarily cut one another in two points into two equal parts: theſe two therefore muſt even do ſo in the *Zenith* and *Nadir*, by the very definition; ſo that theſe two points (the *Zenith* and *Nadir*) are always alike common to them both, as well unto the true, as unto the *Magnetical Meridian*. Where-

Where-hence it followeth neceſſarily, that alway the one half of the *Magnetical Meridian* is on the Eaſt ſide, and the other on the Weſt ſide of the true *Meridian*, the common *Zenith* or *Nadir* evermore keeping their equal diſtances from the Poles of the one of them, as they do from the other. For Example, ſuppoſe the common *Zenith* to be in the *Æquator*, you Sayling Eaſt or Weſt, as long as there is no variation, there is no *Magnetical Meridian*, there are no *Magnetical Poles*, but thoſe of the World. But as ſoon as Sayling ſtill under the line, you do find a variation, it is the *Magnetical Meridian*, that by his ſwarving from the true *Meridian* of the World, in the Horizon ſheweth the quantity of the variation, and giveth it alſo the denomination of Eaſterly or Weſterly, and his *Axis* is the line of variation. But ſuppoſe the common *Zenith*, to be in any parallel, between the Equatour and the Pole, then is it not the *Axis*, but ſome other Diameter of the *Magnetical Meridian*, which ſheweth the variation of the Horizon; and the *Magnetical Meridian* ever more cutteth juſt ſo many degrees of the *Magnetical Almicanter* on the one ſide of the true *Meridian*, as the ſame *Magnetical Pole* is diſtant from the ſame *Almicanter*, on the other ſide of the true *Meridian* from the Pole of the World. And this is to be underſtood in correſpondent manner, as well of the South *Hemiſphere*, as of the North.

The reſpective *Magnetical Meridian* (where any variation is) is a circle that paſſeth by the Vertical point of the *Nadir*, and both the reſpective Poles, croſſing the Horizon at right Angles in the points of variation, of which circle the line of Variation is a Diameter, but where there is no variation the true and *Magnetical Meridian* are both one and the ſelf ſame, and ſo in the like manner are there Diameters. Thoſe circles and Poles are termed reſpective, becauſe that in every place where any variation is, the Magnetical Needle doth reſpect them, as well in the property of direction, as of

that of declination or inclination. For thus alſo very well it may be termed, by the property of direction, and I do mean with Doctor *Gilbert*, the Horizontical motion of the Magnetical Needle, by the declination or inclination. I mean the deſcending (and as it were) the ſinking motion of the Needle under the Horizon, in his proper *Azimuth* or *Magnetical Meridian*; but if there be no variation, the Needle always pointeth to the true *Meridian* of the Earth, and towards the Poles thereof, in both thoſe properties. The true Poles of the Earth, which are thoſe two points equally diſtant from each part of the Equinoctial of the Earth, are always the ſelf ſame. The reſpective Poles alter with every Horizon, where there is any variation, but never out of the forenamed *Almicanter* of that place. The cauſe of the differences of the reſpective Poles and Meridians from the true Poles and Meridians, and ſo of all Variations, are only two; the chief and moſt general is the vaſtneſs of the Ocean Sea, by moiſtneſs whereof the Magnetical collateral force of ſo much Earth as it covereth, is much hindered and dulled. And by what means the next great continent hath more power over the correſpondent end of the Magnetical Needle, then otherwiſe it would have if all were alike, one entire continent; and therefore cauſeth the directive property of the Needle ſomewhat to ſwarve towards that way, which is that which we call variation; but yet the vaſtneſs of the Ocean doth not hinder the declination of the Magnetical Needle, becauſe the hanging conſiſteth but in length and bredth, and not in the depth. For although in compariſon of a Pond or River, the Sea is ſaid to be of a wonderful depth, yet if this depth be compared with a Semidiameter of the Earth, it beareth a very exceeding ſmall proportion, nothing at all to hinder the mighty magnetical declinatory force of the whole Earth; for the greateſt depth that ever any man of ſkill eſteemed it at, was not above two *Engliſh* Miles,

at

at the uttermoſt, when as daily experience maketh it manifeſt, that a great continent will ſhew his Magnetical collateral force, by cauſing a variation, above 200 miles off from the place, and therefore Doctor *Gilberts* fear in that point I take to be needleſs, ſuppoſing a variation of declination. The ſecond cauſe of variation is any great mountainous Region, Eaſterly or Weſterly from you, it will cauſe the Needle ſometimes to ſwarve that way. But variations of this kind are but of ſmall continuance, and in Sailing ſubject to ſuddain alteration; yea many times quite contrary from Weſterly to Eaſterly, and afterwards back again within ſhort ſpace, as our firſt famous Pilot *Stephen Burrough* found by his experience in his diſcovery of the *Scythian* Sea Coaſt, between the North Cape of *Finmarke* and *Vaygates*; the reaſon whereof ought heedfully to be regarded, which is that the Magnetical force of the whole Earth, doth (as in all Magnets) ſhew it ſelf moſt ſtrongly in the two poles thereof, and in the places which are under them: but always muſt be remembred that all the force they have muſt iſſue out of the whole Terreſtial body, as it doth likewiſe in all Magnets out of the body of the Magnet: and therefore in any part of the ſuperficies of the whole Terreſtial body. It is impoſſible that any variation be above 90 degrees, becauſe the virtue of the whole can never be overſwayed by the imperfection of a part, and eſpecially of ſo ſmall a part as any one portion of the Ocean is in his very ſuperficies, in reſpect of the body of the whole Earth: yea I am verily perſwaded, that there never was nor never will be any Variation, by any good obſervation found to be ſo much as 90, neither any ſhew of ſo great variation any where, except it be very near unto either of the poles, where there is ſmall credit to be given to the obſerving of any variation: for the variation being (as before ſaid) the difference of the pointing of the Magnetical Needle in the Horizon, from the true *Meridian*,

for

for as much as in places near the pole, there is no manner of certainty of either of these, it is not possible to find the variation if there be any. The reason whereof is this, no man may Travel in those Seas, but whilst the Sun abideth on that side of the *Æquator*, whereby they have continual day, and by that means are secluded from any help of the Stars; neither if they might be seen, would they bring any great help. For the difference of height in many hours is so small, that by a large Instrument a diligent observer with great pains will hardly find the *Meridian Line*, all the *Meridians* thereof coming so near one to another, and meeting in the Pole, and their Horizon being in a manner parallel to the Æquinoctial. As for the Horizontical Magnetical Needle, to shew their pointing in the Horizon as they were wont to do, they coming into the Climate may say *Fuimus Troes*. Their direction is as it were giddy and uncertain, and when their center cometh unto the pole it self, it is quite vanished away; for from thence all the points of the Horizon are only South, if it be at the South pole, and North from the South, and therefore in that place the Instrument of declination is far more sure then the Horizontical Compass. And as in the poles themselves there is no direction at all, so of necessity near unto them it must be a very confused direction. Those two places that are called the poles, have no strength of themselves (as aforesaid) but as it is contributed unto them of the whole. As in a Magnet, if you break off a piece of a contrary end, the end that is left will be according to that proportion diminished in his strength, and the polar piece, and the polar piece that is broke off (be it never so little) will have two poles as well as the great, so that the two parts will have four poles, two of them North, and two of them South. Put this little piece that was broken off in his place again, and then each piece will loose one of his poles at the very same instant, and the whole will have but two

poles,

poles, the one North and the other South, as at the firſt. Again, if you cut off of one ſide a piece of the Load-ſtone, that is brought into a round or an Ovall form, having his poles marked in their due places at each end, preſently both ends will be abridged of part of the force which they had, and the poles themſelves will be removed unto the other ſide, from the places that were marked, and thoſe marks will ſtand but for idle ciphers in compariſon of that they were before. Again, take a Magnet of an old or an extended Ovall form: I do ſtill exemplify in theſe, becauſe they are of all others, as I have often admoniſhed, for all Magnetical proof the moſt excellent forms, and ſet marks on the two poles, take a fine Needle, or any ſtreight ſmall Wyar, and ſet it on the Equinoctial (mean thereby the middle, between the two ends of the ſtone) then will it point directly towards each pole, if the ſtone be ſound without any flaws, or any other groſs ſubſtance (as may be) intermingled with it: and if you thruſt this Needle towards either end, according to his own direction, he will trace you a circle right over both of theſe marked poles, which is the true *Meridian* of the ſtone. But if this ſtone hath on either of the ſides any imperfection, when the Needle cometh to the edge or brink thereof, it will ſwarve ſomewhat towards the ſounder ſide, and will point to neither of the true poles. And if a circle be drawn according to his pointing, as he ſtandeth ſtill in that place, this ſhall be a reſpective *Meridian* of that ſtone, proper unto that place, and the poles. The reſpective poles differing from the true *Meridian* of the ſtone and his poles. Now if you thruſt the Needle farther towards the end, upon the brink of this imperfection, it will not point (as before) but either further off, or nearer to the true poles, and will give his direction for a new reſpective *Meridian*, and new reſpective poles, and in ſuch manner infinitely, if you place the Needle in the middle of this imperfection, equally

ly distant from the sound parts, then will it indeed point towards the end of the stone, and the consequence hereof is the main reason, and that towards the middest of the Ocean; and likewise of any great continent there is no variation. Thus may you especially in a round Load-stone (as in a lively example) see the true causes of all the variations that are in the whole World, reckoning as much space as the Ocean covereth, to be some imperfection in the body of the whole, in respect of the Horizontical motion of the Compass. For the evidence of the truth hereof, let a man examine generally the variations of the most expert Navigators (although by reason of the diversities of the sets of their Compasses, and unfitness and unapt handling of their Instruments, they seldom times agree amongst themselves) observed in the *Atlantick Ocean*, from the *Æquateur* unto the parts of *Norway*, all along the East Coast, from the *Meridian* of the *Azores*, so as far North, as hereunto has been discovered, and he shall find the ordinary practice to testifie the truth hereof, as also after the same sort from the *Æquateur* Southward, unto the Straights of *Magellan*, and all along the back side of *America* in the South Sea: on the East Coast on the Cape of *Bona Speranza*, and he shall perceive the like agreement, but in Sailing from the cap of *Bona Speranza*, farther farther Eastward that sometimes they do find it otherwise, the cause is the different manner of the situation of the South, as yet undiscovered continent. And whereas in the middest of the *Atlantick Ocean*, about 30 Leagues West from the *Azores*, they find no variation at all, no mervail thereof; for it is about the middle distance between the two great Continents of *America* and Ours.

Wherefore the round Load-stone is significantly termed by Doctor *Gilbert Terrella*, that is, a little, or rather a very little Earth; for it representeth in a little small modell (as it were) the admirable properties Magnetical of the huge Globe of the Earth; herein also we may behold the reason why the Magnetical Needle

Needle varieth leaſt in the Æquinoctial, and moſt towards the pole, and in the poles themſelves giveth no direction at all: for proof hereof, take a Needle and place it on the Æquinoctial of the ſtone, there you ſhall ſee ſtand equally ballanced and very ſtrongly, ſo that if you turn him from the direction, as ſoon as you let him go, he will preſently again turn to it. The reaſon is, becauſe each pole doth equally ſtrengthen his correſpondent end of the Needle. Move this Needle towards either of the poles, then doth the nearer pole ſtrengthen his end of the Needle; but the farther (becauſe of the diſtance) cannot do the like unto his, but very weakly, and this Needle will not ſtand any more equally ballanced (as it did in the Æquinoctial) but that end next to the pole will couch down, and the other will riſe up, for on the North ſide of the *Æquatour*, the true South end is predominant, and on the other the North end hath the Maſtery. And that this is alſo in the Earth it ſelf, all our late Travellers confirm unto us by their daily experience, and all the very Artizans and Needle-makers muſt needs be daily witneſſes of it. As for Example, let any Workman in our Climate make a Needle for a Dyal, when he hath fitted it and placed it on the pin, that it may ſtand thereon equally ballanced and parallel to the Horizon, touch it with the Loadſtone, then preſently that which pointeth towards the North will hang down; yea (although you touch only with the South end) and will not ſtand as before, the touch equally ballanced and parallel to the Horizon: except that you cut or file ſomewhat from that end that hangeth down, or elſe add a piece of Wax or ſome other thing to the other end of the Needle to counterpoſe it, and make it ſtand equidiſtant as it did at the firſt ſetting on: and this is a thing very certain, that is, the Northerly deſcent of the Needle, will be more or leſs in all places of Northerly Latitude: in the greater Latitude the more, and in the leſſer Latitude the leſſer.

But

But if any Traveller carry this Needle beyond the *Æquatour* in the like Latitude Southerly, that end which is downwards in the Northerly, will rise Southerly, and the other sink down even as much: and the nearer you Travel towards either pole, the more that end which pointeth towards the pole will tend downwards: this is most certain in every Dyal Needle, but a great deal more appeareth in a long one then in a short one; we cannot find that the property of direction by the Magnetical Needle hath been unlargly practiced (for Sailing) above 300 years. And as for the property of declination under the Horizon, thereby to shew the Latitude by the Instrument thereunto belonging, it is as yet a very new come Gueſt into the World, born and bred with us in *England*, and except it had been in exceeding few mens hands, yet much used, much less come unto his perfection. But this is not to be marvailed at because it is not above 60 years old; neither is it to be wondered at if any Critical Fellows do contemn and deride it, forasmuch at either their want of knowledge, or of patience, will not give them leave truly to consider of it. But what Navigatour, or rather Nugatour whatsoever contemneth it, shall be sure to repent if ever he comes to his right wits to consider what it is that he hath contemned. And although the Needles for direction and declination do differ much in their shapes, each from the other, yet the properties are both one and the same. For the Needles for direction do decline (as aforesaid) as far as the unfitness of their form and place will permit them: and the declining Needle will not work, but only in his *Magnetical Meridian*, which himself will find out, if you turn the Instrument about, untill the Needle shew his least declination under the Horizon, and there do play up and down, and stop in the end of the same place again. But if you would have a Needle fitted to shew both his properties, do thus, cause a Needle to be made about

six

ſix Inches long, even and ſmooth, ſaving that he muſt be a little bigger in the middle, then inſtead of an Axis (which declinatory Needles have) let him have a ſmall hole drilled preciſely in the middeſt, and this hole being very ſmall, let it be ſomewhat wider outwards on each ſide then in the middeſt (which our Workmen call Sinkboared) where it muſt be left very ſharp, even almoſt as the edge of a Knife: put through this hole a ſmall Virginal Lattin Wyer, and fit the Needle ſo that it hang preciſely even upon this Wyer, inſtead of an Axletree; then touch him with the Loadſtone, and you ſhall preſently ſee the end that ſhould point towards the North, decline or bend down to his due point of declination, if it be placed in the Magnetical *Meridian*, and ſet a little piece of Wax or any other thing upon the contrary part for a counterpoiſe, in that the Needle may ſtand parallel with the Horizon, then if you ſtand at right angles with that Virginal Wyer, it is certainly in the Magnetical *Meridian*, ſo that hanging in this counterpoiſe, if you turn about the Wyer untill the Needle do make right Angles with it, then doth the Needle by his directive virtue point unto the Magnetical *Meridian* Line. Take off the counterpoiſe, then it ſheweth the declination; ſo that one and the ſelf ſame Needle in the ſame place only, by taking off, and putting on a little piece of Wax, ſheweth plainly both thoſe properties of directions and declinations, and in like manner every inclinatory Needle will do, if the points of his Axis be ſharp, and held in his box parallel to the Horizon, he will ſhew both thoſe properties of direction and declination: a fine piece of Cork or Leather, or any Tough ſubſtance may ſerve this Needle for a counterpoiſe in all Latitudes by thruſting it towards the center in the leſs Latitudes, and towards the end in the greater, and I think it not impoſſible, but that a ſkilful Geometrician may ſo graduate the one half of ſuch a Needle, that it alone with its counterpoiſe, may be a means

to

to give a probable conjecture for the Latitude of any place whatsoever.

It will be very convenient in the next place to make a discovery of the Errours committed in making and touching Magnetical Needles and Wyers of Sayling Compasses, and to give advise for the true and right making and touching of them.

First, The Wyers that are commonly made both with us, and in forrain Countries, are of so base and drosse Iron, not apt or sufficient to receive the tenth part of the virtue that fine Steel Wyer could do.

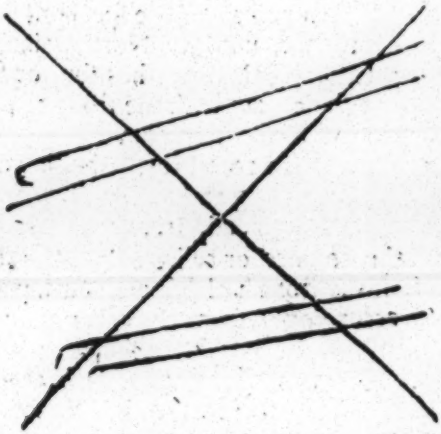
Secondly, The ends of the Wyers are for the most part not filed smooth or fitted even together upon the Axis of the file; by means whereof the touch of the stone is more dully received, and the standing of the file more uncertain, the Magnetical force not being in the true Axis thereof.

Thirdly, Their manner of touching the Wyers is altogether pitiful and ridiculous. For with a Load-stone having a point (for sometime they have a stone so well fashioned, that both points are eminent) that toucheth the North (and such a one though he be but weak is preferred amongst them before another, though much stronger that toucheth to the South) they rub to and fro those ends of the Wyers, which they would have stand Northerly. Wherein what do they else, but play as it were fast and loose, not considering (as the truth is indeed) that every touch from the ends of the Wyers to the center of the File withdraweth back again that force, which the contrary touch did give them, and therefore seldom give they above one quarter of that strength, and sometimes not so much, which otherwise with the very same stone they might do, if they ordered all things as they should: yea, I am infallibly assured (for I have had certain experience of it) that with the same stone you may give fully as much, and rather more force, touching in such sort as

immediately

immediately ſhall be declared on the upper face of the Fly: over againſt the Wyers (the Card being between) then they do by touching the very Wyers themſelves after their wonted faſhion: whenſoever therefore a Needle is to be touched, beſides the goodneſs and quantity, you muſt have a regard to the form of your ſtone, namely, whether it hath both the North and South points eminent and forcible, or only the one, for if it hath both, begin your touching near the middle, preſſing the true North point, before ſpecified of the ſtone all along from thence, unto the North pointing end of the Needle; Iterating thoſe touches four or five times, always making ſome ſtay with the ſtone at the end of the Needle. But if the ſtone have but one forcible point, then if it be the true North, begin your touching at the South pointing end of the Needle, preſſing it all along to the North end, Iterating this four or five times, and thence once or twice only from the middle to that end, if the ſtone hath but the South point, touch the Needle accordingly from the other end; for even as the virtue of the ſtone it ſelf is ſemidiameter having his begining (as before is mentioned) in the center of the ſtone, even ſo the force which he impparteth to the Needle, is in the nature of a Semidiameter in the middle of the Needle. Inſomuch that a Needle being touched from the middle into the other end of the Needle, ſo that the ſtone be good, and the Needle but of a reaſonable convenient ſize, as you may evidently trie in every Knife of ordinary goodneſs and length. But a plate of Steel made at both ends alike, according to the form here above deſcribed, is much better to ſhew this effect. For when the Blade of a Knife is of fine Mettal, the Halft being of courſe Iron, and alſo of divers form and temper, it is not any way capable of the like force as the Blade is, which is the reaſon that if you touch the Blade of an Iron Hafted Knife from the halft unto the point with a Load-ſtone, it will at the point take up its competent

competenth weight, touch it back again to the uttermoſt part of the Haft it will take up little or nothing: try the like with ſuch a plate or ſteel, and you ſhall find it take up fully as much at the one end as it did at the other; but if you bring his touch to the middle, it will take up little or nothing at the other end, and nothing at all in the middle it ſelf. The reaſon hereof is



this, the Magnet giveth his force (*ſecundum Menſurum recipientis*) according to the capacity of that which receiveth it, and that evermore after his own nature, which is to have his force ſtrong in his ends, and none at all in the middle, if you touch the blade from the middle, with either end of the ſtone, the other end of the halft will immediately receive and ſhew the contrary quality: even ſo alſo will it come to paſs if you make proof with any Magnetical Needle, although that his force will be faint and weak in compariſon of the other. And in your touching you muſt obſerve that in preſſing with the ſtone from the middle of the Needle unto the end, as you bring your hand backwards to iterate the touch, you muſt lift your hand ſomewhat high, and not bring it backwards, cloſe to the Needle, for that would diminiſh the ſtrength of the touch. But if that end of the Needle be alſo touched with the other end of the ſtone, in the manner as I have before rehearſed, then ſhall he at each

end be a great deel the ſtronger, and the contrary fainter forces ſhall recoile and ſettle in the middle of the Needle, where they can nothing at all diſturb the motion thereof. We ſhall next diſcourſe of the touching with a Load-ſtone capped or without a cap, by caping is meant the placing of two pieces of Iron handſomely fitted and faſtened upon the two points of the ſtone, for Iron for this purpoſe is better then ſteel. And likewiſe concerning the weight that is to be lifted up, it is better to be made of ſoft Iron then of Steel, and the ſtone will lift more thereof, as long as there is a contiguity: but if the Iron and the Steel be ſeperated from the contiguity of the ſtone, the Steel will always carry at the leaſt

ten

ten times more virtue then the Iron, as it is before mentioned. Now whether it were best to touch the Wyers with a Magnet being thus capped, or with the bare Stone it self, some there be that make a question; I have been told by one of great skill and practice, that he found by experience, the Compass touched with a capped stone, not to receive his force so well as the other, and the party coming to me when he was to undertake a long Voyage, to have his Compass touched, requested me in any wise to do it with the bare stone: but yet I think it very good that this be confirm'd by more than one mans experience before it be believed, because by some errour he might possible mistake the matter. Sure I am that the capped stone giveth somewhat more virtue in his touch, and by all experience that I have made, I find it to continue as firmly and as long; howbeit I refer my self herein to the tryal of others also. A man may therefore touch the Wyers with the bare stone, and then with the same being capped, or contrariwise to be furer of the greater force, and yet if any shall imagine the difference of the strength of the touch, to be according to the taking up of Iron with the cap or without it, he is very much deceived; for I have often tryed them both, but never could see the touching strength of the Needle to be increased half a quarter more with the cap then without it; whereas I have always (especially if the stone were very good) found that the stone will lift ten times as much Iron: yea, a great deel more (and sometimes twenty times) with the cap (if it be artificially fitted) then he is able to do without it.

Some, who would seem to be of great skill, have imagined that the best way to add strength to a Needle, is with a Hammer to give some strokes to the point of the stone, thereby causing Litrages (as it were) or Beard, to hang down from it, and that the Needle in his touching, taking some part of that with him, should have the stronger touch. But they that so suppose deceive themselves

themſelves therein; for a Beard is nothing elſe, but the fine duſt of the ſtone, hanging together by virtue thereof: which being ſeparated from the ſtone (although it were a right good one) is not able any whit at all to turn a Needle of it ſelf. The tryal is ſoon made by this means, let them take off that beard from the ſtone with a ſtick, and lay it upon the end of a Needle not touched, and they ſhall find in it no force at all, nay it is hurtful to the Needle, for it giveth a ſuperfluous burthen for a ſmall time, and cannot but incumber his action, by reaſon that every one of thoſe little parcels of duſt (though beaten out at one end) hath alſo for its ſmall quantity both a North and a South virtue. And therefore marreth as much as it maketh at either end of the Needle. The proof hereof is manifeſt, if you put off that duſt or beard upon a paper, and hold a Lead-ſtone under it, for as you turn towards the paper the North or South of the Stone, ſo will every one of theſe particles in like manner turn it ſelf, ſhewing thereby a double nature.

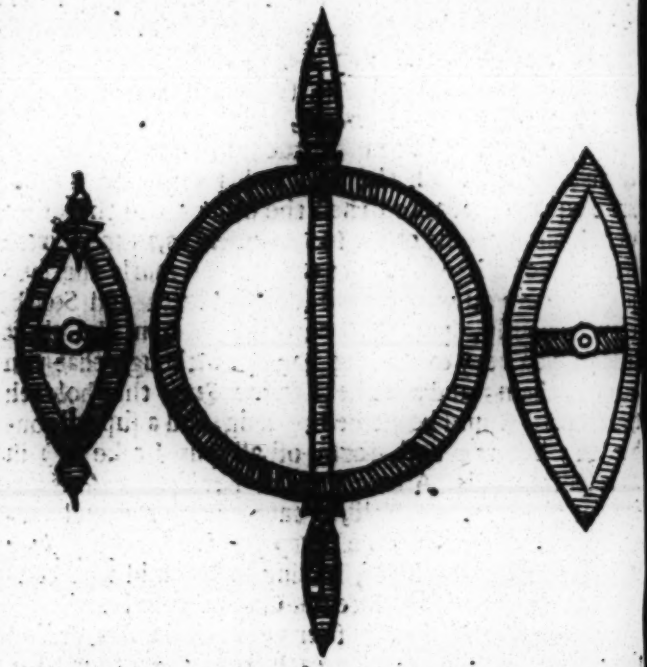
The Compaſs Needle, being the moſt admirable and uſeful Inſtrument in the World, is both amongſt ours and other Nations for the moſt part ſo bungerly and abſurdly contrived, as nothing more. And therefore as I have treated of the nature and uſe of the Magnet, I have thought good alſo to employ my beſt endeavour, to advance this noble Inſtrument towards its higheſt perfection, being the principal thing by which the worthy effect of the Magnet is made moſt profitable unto Mankind, herein five things are to be conſidered, the ſubſtance that it is made of, the form, the weight, the capitell, the pin it ſtandeth upon: the ſubſtance in any wiſe ought to be pure Steel and not Iron; for moſt aſſuredly Steel will take at the leaſt ten times more virtue than Iron can do, but eſpecially if it hath its right temper. And that is this, heat it in the fire untill it be paſt red hot, that it be whitiſh hot, and

quench

quench it in cold Water ſuddenly, ſo is it Brick in a manner or Glaſs it ſelf, and is at that time incapable of the virtue of the Load-ſtone. Then muſt you, laying it upon a plain Table, warily rub with fine Sand all the black colour from it, if before you put into the fire you anoint it with black Soap it will ſcale white it ſelf, then heat a Bar of Iron well near red hot, and holding one end of the Needle with a ſmall pair of Tongues, lay the other end upon the hot Bar, and preſently you ſhall ſee that end turn from a white to a yellowiſh, and afterwards to a blewiſh colour, then take that end with your Tongues, and do the like to the other, thruſting it forwards upon the Bar untill the colour of the whole Needle become blewiſh; then throw it on a Table, and let it cool it ſelf; and ſo is he of the excellent temper, and moſt capable to receive the greateſt power from the Load-ſtone. If this ſeem too curious, eſpecially for ſome faſhions of Needles, then uſe but the Hammer hardening (as Workmen call it) which is well near as good. As concerning the form, divers men are of divers minds, ſome uſe a kind of a ſquare one, others a Loop (I mean an extended Ovall form) and this is moſt common; but now a days a narrow ſtreight plate (being ſomewhat broader in the middle) is in great requeſt: of theſe I hold the Loop or Ovall form (if it be well made) to be the beſt, which is, that if it be Steel, his ends be welded together, having a Lattin narrow plate, iſſuing from the capitell unto the middle of the two ſides of the Loop, and there rivited, and riviting, if it be handſomely ſhoulered in by the Workman, is better than ſoadering; becauſe having fitted the Lattin plate bearing the capitell unto the Loop, you may firſt put your Loop into his temper, and then rivet this unto him afterwards, which otherwiſe would be ſpoiled in the fire, and the wide Loop is better then the narrow or the ſtreight plate, and that for two reaſons. The one is becauſe, as in a Magnet it ſelf, the force that is in

in the whole body, ſheweth it ſelf moſt ſtrongly in his two Poles, even ſo, this being a Magnetical Body, doth the like in his ends, which are his Poles: and the end of a wide compaſſed Loop, (being longer than of a narrower) of the ſame length, in the Axis, muſt needs contain ſo much the more Vertue; The other reaſon is, becauſe it ſuppoſeth the Flie in his Circular Motion, more equally ballanced then the other: and therefore were it not for ſome other Inconveniences, a true Circle were beſt of all, which that except you mark the two places, that you would have for the North and South, very curiouſly, you ſhall never give him the right touch; yea very exceeding hardly, although that you do mark them; and alſo the Lattine *Stay* that holdeth the Capital would be exceeding long, and a ſuperfluous burden; but the beſt form of all (as I take it) in all reſpects is this, A true Circle, having his Axis going out beyond the Circle, at each end narrow and narrower, unto a reaſonable ſharp point, and being pure Steel as the Circle it ſelf, having in the midſt, a convenient Receptacle to place the Capital ſitly in.

This Circle muſt have four very ſmall holes drilled through it, equally diſtant each from the other, for the four Cardinal Points; and in both the two Points, that iſſue without the Circle, being for North and South, of equal diſtance between the Circle and the end of the Point two more; if it be a large one, otherwiſe one is enough, according to the following Figure. And this Needle is moſt fit to be uſed for the Obſervation of the Variation without any Flie, as I will hereafter ſhew.



Whenſoever you will ſet this Needle unto the Flie, you muſt put the Capital through the Center of the Flie very preciſely, and placing the Points of the Diameter where you will have them, thruſt little ſmall pins through the upper place of the Flie, and thoſe ſmall holes in the Needle, the heads of the pins will ſhew you (if the Flie be larger then your Needle) at what Point your Needle ſtandeth, and bowing the body of your pins, (being thruſt through thoſe little holes) cloſe to the Card below, will keep it ſteady at that place, and from warping alſo. And ſo four pins at the four Cardinal Points will ſerve the turn.

Again,

Again, If you please to place this Needle upon the upper end of the Card according to *Stevinus* thorough the Center, in the bottom of the Flie, and the Needle placed and fastened on the top, or upper face of the Card.

But if you will have a Magnetical Needle to serve only for one size of a Flie, the best way is, instead of the two pins in the end of the Axis, to have a couple of little half Staples, and a Flower-de-Luce on one of them, as you see in the Loop revitted there: That in turning about the Needle, they may still keep the Flie close unto it, and so fasten it upon a Skrew upon the Capital, wheresoever you please.

As for his weight, it must be according to his largeness, and the weight is one principal cause, the very large Compasses are unprofitable. For the weight of the weight of the large Card, and the heavy Needle, pressing upon the pin, will cause the Motion of the Flie to be dull and uncertain; and therefore let the Pasteboard be no heavier then you must needs; and for the size of six Inches Diameter of your Paste-board, and a Needle of that length, I know that a Needle of half an Ounce weight, and half a quartern at the uttermost, (if a good Workman have it in hand) will be fully sufficient of what Form soever.

The Capital ought to be Lattin, and Hammer-hardned, well and truly boared, not too shallow, but of a good convenient depth and wideness at the bottom, fitting the pin it standeth upon at the top.

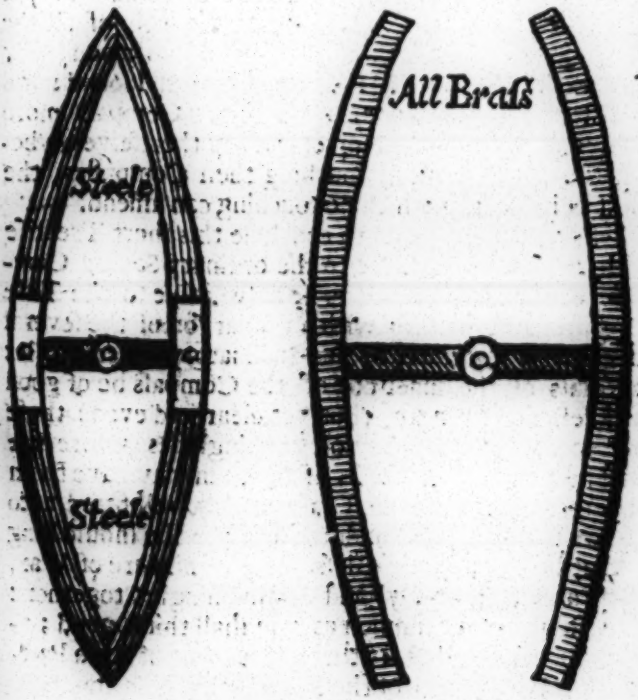
The Pin ought to be either of Lattin or Copper, and not of Steel or Iron, as some suppose; for they are very subject to rust; and the Steel, especially by long use, will wear a little hole in the top of the Capital, and by that means the Compass becometh dull, and they hardly if ever will find the reason of it; for the hole will be very small; and entring a very little way in, and yet disturbeth all. Moreover, in any wise there

muſt be always an eſpecial diligent Care had of fitneſs between the Capital and the Pin, otherwiſe all things appertaining to the Compaſs are nothing worth. This Pin muſt be very firmly fixed in the juſt Center of the Box, and the bottom marked, that whenſoever you take it off to ſharpen the Pin (which uſe will make blunt) you may ſet him in the ſame place again.

As I have ſaid, that in a Magnet it ſelf, the Vertue is in the whole body, and ſheweth it ſelf moſt forcible in its Poles; even ſo likewiſe our Compaſs Needle, being a Magnetical body, ſheweth his force in his ends, which are his Poles, although that force doth proceed out of the whole body of the Needle; which I have now thought good to make apparent by an evident Demonſtration: I cauſed my Workman to make a Needle of a Loop Faſhion, eight Inches long, or Oval Form, in all reſpects fitted to be ſet to a Flie, ſaving that there was but one Inch or a little more at each end of the Steel, all the intermediate part between the two ends being of Braſs: Theſe two ends I did touch with the North and South ends of a very good Magnet: and whereas in a true Magnetical Needle, I ſhould have had but two points, the one North, and the other South, this Mongrel yielded me ſix, the two ends adjoyning to the braſs of contrary natures unto the ſharp Points, and would no more do the Office of a Magnetical Needle then a wooden ſtick, becauſe the Vertue was not in the whole, and ſo communicated unto the two ends, but each end was a Total of himſelf, being ſeparated, and as it were divorced, the one from all communication with the other, by that intermediate braſs: the which being taken away, and the two Forks joined together for that length, preſently he became one perfect true Magnetical Needle, and the Vertue of thoſe four confuſed Points, which ere while was loſt in the Forks, will preſently be found in the two ſharp ends, and now in his natural Seats.

Both

Both theſe ends of Steel were faſtened to the Braſs, and then that Needle had no Magnetical Motion; but being taken off and joyned together, they preſently (without any further touching of them) became a true Magnetical Needle.



To conclude this diſcourſe of the Compaſs of the Needle, the needle that is ſtill working upon his Pin continually, will keep his force the better, then that which otherwiſe laid up, although there be no doubt of the other, for a mans whole Age, or longer, if it

be of good Mettal, and kept from open Air and Ruſt, but eſpecially of any Load-ſtone. There is no better way of keeping from ruſt, then by varniſhing him, although it be but with a drop or two of Linſed-Oyl alone, the Needle that is continually upon his Pin, is ſtill ſtrengthened by the Magnetical power of the Earth, ſetting himſelf always towards the Poles thereof (which the other cannot do) and needeth only to have his pin ſharpened only now and then: the which of all the faults incident to the compaſs, is moſt eaſily and ſafely amended. And yet if it be not very well looked unto, it diſturbeth all the operation of the Compaſs more then any other. And divers wrong themſelves in being too buſie in often touching their Compaſſes, the fault being in this which no touching can amend.

I have thought good to conclude this ſhort Treatiſe with a little additament to the ordinary Sailing Compaſs, fitting him thereby to be anſwerable to the Tables here prefixed, as alſo with a conparation of the ſeveral uſes of the Horizontical and Inclinatory Circles. Let the glaſs of the inner box of the Compaſs be of good thickneſs and ſtrength, (but yet clear and even) ſuch that come from *Venice* for Looking-glaſſes before the Soile be ſet on are the beſt, if any Man may have them large enough. Let this Glaſs be very well fitted unto the box and ſimmoned underneath upon the ſhould'ring of that beareth up the Glaſs, with a mixture of Wax, Turpentine, Sallet-Oyl and Roſin mingled together: or with any other ſimilion as you ſhall think good; above upon the Glaſs let there be a Ring of thin Paſtboard, of the breadth of the Should'ring underneath, in like manner ſimmoned on: then muſt you have a circle of Lattin about the breadth of the Paſtboard Ring, of convenient thickneſs for ſtrength, which muſt be divided into degrees: this circle muſt have a plate of Lattin, of half an Inch broad or broader, according to the largneſs of the circle for ſtrength, that muſt croſs

over

over the middeſt of the circle, cut out of the ſame place with the circle, or elſe ſoadered with Silver ſoader: this muſt have a line all along the middeſt of it, and a little loop at each end cut through the two ends of the loops being preciſely in that line. Laſtly, you muſt have a moveable Ruler with two long folding ſights, of about the Semidiameter of the circle in the breadth above half an Inch: the one of them muſt have a ſlit through the length thereof, of about a quarter of an Inch broad, as you ſhall think convenient, and two little holes, the one in the top, and the other in the bottom, juſt in the middle of it, to faſten a ſtring, having a very little bead to ſlide up and down upon it. And this ſight muſt be of thicker ſtuff then the other; for otherwiſe becauſe of that which is cut out it would be overpoiſed by the other, and ſo the box would ſwarve towards the other; and the ſights muſt each of them have a little notch in the middeſt of the top of them: this Ruler muſt be faſtened (but yet ſo that he may turn about) in the middle of the croſs plate moſt preciſely in the center of the circle, his ends cut, that he may ſhew the Fiducial Line in the diviſions of the circle, the other ſight needeth to be but a plain plate, having a line in the middle, from the top to the bottom, being the very ſame in ſubſtance with that which we call the compaſs of variation; although in all things eaſier performed with this, then with that.

The Compaſs being thus fitted, place the circular Needle upon his pin alone, without any ſlie. For, being diſburdened of the Card, he will ſhew his virtue the more ſtrongly, and being of the right form, he will ballance himſelf ſufficiently.

Place the circle upon the Glaſs and Paſt-board; in ſuch a manner that you may turn the circle round about, very cloſe and even, within the brim of the box.

When you will ſet the ſame unto the Compaſs, turn the circle about, untill thorough the Loops of the mid-

dle ſtay or plate, you ſee the Axis of the Needle right under the Fiducial Line of the middle ſtay, then holding the circle ſo, turn the moveable Ruler with the ſtringed ſight towards the Sun, untill the ſhaddow of the ſtring fall upon the Fiducial Line of the moveable Ruler, for then doth the end of the Ruler, among the degrees, ſhew the true place or azimath of the Sun from the Magnetical Meridian, ſo that two obſervations neceſſarily ariſe from hence, the one in the Forenoon, the other in the Afternoon, thus made, with the ſeveral heights of the Sun, being one and the very ſame, half the differances of thoſe places of the Sun, from the Magnetical Needle is the variation.

If a man have no exact Inſtrument to take the height of the Sun, he may make ſome reaſonable ſhift, by ſetting the middle bead towards the top of the ſtring, that it may in the Forenoon caſt a ſhaddow upon the Fiducial Line of the Ruler; and marking that place with Ink or Black-Lead, in the Afternoon attend, untill the ſhaddow of the bead (the bead remaining ſtill where it was full upon the place) for then ſhall you have that ſame height, if you will take the amplitude of the Suns riſing or ſetting, ſet the circle, and turn the Ruler as before, untill the ſhaddow of the ſtring do fall upon the middle Line of the other ſight. Then doth the end of the Ruler ſhew how far the Sun riſeth or ſetteth from the Magnetical Meridian.

When you will take the Amplititude of the riſing or ſetting of any Star, you muſt uſe the help of another, to hold the circle over the Needle (as before) and ſo you turning of the Ruler, untill you ſee the Star in his riſing or ſetting, through the two notches on the tops of the ſights, then doth the end of the Ruler ſhew your deſire. The like is to be done in obſerving any cap, or the tendings of any Land for the deſcription of any Coaſt.

The Horizontical and Inclinatory motions of Magne-

tical

tical Needles are both of them but one and the ſame effect of the Magnet or Load-ſtone, the making of the Horizontical or Dial-Needle, it is amongſt our Artificers very well known and trivial, only they are to be put in mind that they do always make them of pure Steel and not of Iron. But as for the making of Inclinatory Needles, it is a very curious piece of work: it muſt be of pure Steel, and in his right temper, the Needle and Axis muſt be as right Angles the one with the other, and muſt be ſo hanged on the two ends of his Axis, that he be very pliant for his motion, and that before (he have his touch) he be ſo equally ballanced, that the one end be not one jot heavier then the other, for if it be, all the reſt is in vain.

When you will uſe the inclinatory Inſtrument, thus you muſt do, hanging by his little Ring, turn him about untill he make his leaſt declination (or inclination) under the Horizon of the Inſtrument: for then is he juſt in his Magnetical Meridian, and there ſheweth his due point, the which otherwiſe he can never do. But here I muſt forewarn you of two great errours publiſhed in the contriving of this Noble Inſtrument. The one is, that he would have a little box with a Horizontical Needle faſtened unto the bottom of the Inclinatory Inſtrument: for to direct the Inſtrument unto the Magnetical Meridian; and by his picture of the Inſtrument his diſtance ſhould be but a little more then an Inch, whereby it is impoſſible but that the one Needle muſt needs diſturb the other, ſo that neither of them can ſhew a right, yea, although they were ſix Inches aſunder and more, where the little box will give little direction for that purpoſe: and beſides that, it is altogether unneceſſary, becauſe the Inſtrument will find the Magnetical Meridian, by the leaſt declination of the Needle (as is before ſhewed) under the Horizon, without the help of any other. The other errour is this, that he would have that end of the Needle prepared

to hang towards the North, to be framed ſomewhat higher then the other, as it is uſual in Horozontical needles; what Workman ſoever obſerveth this Direction, I will aſſure him, that he ſhall looſe his labour, and as ſoon may he waſh a *Blackamore* white, as to make ſuch a needle as that turn. The reaſon is, becauſe it is only the Magnetical Vertue that worketh this effect, the which over-weight, in the either end of the needle (in this Motion) doth utterly overthrow.

For Horozontical needles in our Northern Climates, it is neceſſary; but for inclinatory needles, it is utterly untrue in all Climates of the whole World whereſoever. The Motion of the Horozontical needle, is naturally ſtronger then the Inclinatory, for two cauſes, the one is, becauſe his Motion is only ſide-ways, the which is the eaſier for the Magneaical Motion to work in, then that which is up and down, and there is no difference which way you place the Box wherein he ſtandeth, ſo that it be parallel to the Horizon; whereas the Inclinatory Motion is in a Vertical Circle up and down, and muſt ſtand only in his Magnetical Meridian to perform his Office. The other cauſe, is becauſe of the Diverſity of their placing in their Boxes; for the Horizontical needle ſtandeth more fitter for his Motion, being placed with his Capital upon the point of a ſharp Pin, than the Inclinatory can do, being placed upon the two ends of his Axes, although never ſo near the Points: But yet he will do very well if he be rightly fitted: and for Navigation under either Pole (if there be any paſſage that way) it is the only Inſtrument of the World, for where the Horozontical needle (or Compaſs) faileth, he is ſtrongeſt, for the nearer the Pole, the ſtronger he is in his motion; contrariwiſe, it is with the Horozontical needle or compaſs, for he is ſtrongeſt at the Equinoctial, and of no force under the Pole.

The

The reaſon whereof is this, under the Equinoctial, the Horozontical needle ſtandeth parallel unto the Axis of the Earth, and is equally ſtrengthened for his Motion with the two Poles of the Earth; but under the Poles, he ſtandeth croſs-wiſe at right Angles with the Axis, his Center repreſenting the very Pole of the Earth it ſelf; ſo that the Equinoctial, and the Horizon being there all one, if the needle ſhould have any Horozontical Motion there, it muſt needs be an Eaſt or Weſt Motion parallel unto the Equinoctial, directly contrary to Nature, and to all Magnetical Doctrine.

Yet at the Pole the Inclinatory needle is at his cheifeſt ſtrength, framing himſelf to be in the ſame direct Line with the Axis of the Earth it ſelf: ſo that the Vicinity of the neareſt Pole of the Earth, holdeth his convenient end of the needle moſt ſtrongly, being nothing at all hindered by the adverſe Pole, to affect the upper (or other) end of the needle: The which all other Scituations either more or leſs it doth, and eſpecially under the Equinoctial, where each Pole affecting his convenient end of the Inclinatory needle, it muſt ſtand very untowardly and unſteadily for that Motion; although moſt ſtrongly for the Horizontical if you place him accordingly.

Where hence it followeth, that near the Equinoctial Large Compaſſes, and ſmall Inclinatories are fitteſt; and near the Poles large Inclinatories, and ſmall Compaſſes are beſt, for look unto what Motion the Magnetical force is weakeſt, the ſmaller Inſtrument ought to be applyed.

And moreover, forasmuch as the Magnetical Revolution of the Inclinatory needle, about the Globe of the Earth maketh his Motion for the difference of every alteration of Latitude to the Equinoctial, far more large and eaſier to be diſcerned, then it can be near the Poles; therefore (as we have ſaid) a leſs Inſtrument

ment will ſerve the turn there: and becauſe that near the Pole, his Motion for differences of Latitudes are exceeding ſmall, and hard to be diſcerned: Therefore very large Inſtruments Inclinatory are there to be uſed, eſpecially becauſe the Magnetical ſtrength of the the Needle for that Motion, is there ſo ſtrong and ſteady, that it maketh ſome Recompence for the ſlowneſs of his moving; and therefore I ſuppoſe that three in Diameter, will ſerve near the Equinoctial, and fifteen near the Pole.

And becauſe this great one may be the leſs cumberſome, you may cut off the Circle at forty and five Degrees of each ſide of the Zenith and Nadir of the Inſtruments, and yet leave the needle ſcope enough, for all the Latitudes between ſixty Degrees and the Pole; and for the ſteady ſtanding of the Inclinatory Inſtrument at Sea, you may do thus; about the middle of the Inſtrument (or rather ſomewhat above the middle) let there be two round Pins of Braſs, about three quarters of an Inch long, iſſue out; and in a Box of a ſayling Compaſs, the miner Circle being taken away, make of each ſide two half round notches in the outer Circle, and place the Inſtrument upon thoſe two Pins, the which muſt have towards their ends, little Circles cut in, that they ſlip not out of their rings that they are placed in; then will this Inſtrument ſtand as ſteady even at Sea, as the ſayling Compaſs will do; for the Motion of the miner Circle is performed by the turning of thoſe two Pins in their notches, and the outer Circle is common unto them both, always remembring that you hang ſome pretty weight on the bottom of the Inſtrument, to make his Motion more certain: If the ſhadowing of the box hinder your ſight from diſcerning of the Point that the needle ſtandeth at, it is ſoon helped with the light of a little wax Candle put down unto it; and yet this you ought to underſtand as aforeſaid, that the Horizontical and Inclinatory Motions

ons are but one and the ſelf ſame Effect of the touch of the Load-ſtone, and one and the ſelf ſame needle will very well perform both Motions; namely, the Inclinatory needle, not the Horizontical, becauſe his placing upon the Pin maketh him very unfit for the Inclinatory Motion. But the Inclinatory needle reſting with one point of his Axis (the points of his Axis being very ſharp) in his little hole, his box being placed parallel to the Horizon, will perform the Horizontical Motion very well. For being placed with the ſharp point of the Axis in that hole, it is all one in effect, as the Horizontical is with his Capital on the ſharp point of his Pin, but that the one is upward, and the other downward, and yet either of them being as fit for that Motion, as the other.

Herein now appeareth the wonderful Wiſdom of our God, in limiting his Times and Seaſons, for the Revealing of theſe wonderful Propetties for the uſe of Men, in the poor ſtone of the Magnes; namely, that (as ſome will have it) above 3000 years after that it was known and wondred at in the World, for lifting up Iron; (for it was ſaid to be, I know not upon what account, eſteemed as an Antiquity in *Plato's* time) the uſe of the Horizontical needle was not known in common uſe, much above 200 years ſince; and very few years after, (yea ſcarcely till of late) the Inclinatory hath been in any common uſe: And who is there that can behold and conſider both theſe uſes, *viz.* both to ſhew the Quarters of the World (as *Eaſt*, *Weſt*, *North* and *South*, *&c.*) And alſo the Latitude of place; to know both theſe in any place of the World, be the Heavens never ſo much over-caſt with Clouds; who is he I ſay, that can behold theſe two admirable and precious uſes performed, even with the turning of an hand; the which, neither the *Grecian* Philoſophers, nor the fine-witted *Romans*, nor the *Perſian Magi*, nor the *Indian Gymnoſophiſts*, could find out with all their skill,

and

and cunning, but he muſt needs ſay with that Kingly Prophet, *O Lord, our Lord, How great is thy Name through all the Earth? Who hath ſet thy Glory above the Heavens?* He hath made of one blood all Nations of men to dwell on the face of the Earth, and hath determined the times before appointed, and the bound of their habitation that they ſhould ſeek to him.

If any ſhall have a mind to quarrel or write againſt that which I have ſo long ſtudyed, and ſpent my time in; chiefly to comfort my Mind, and to be refreſhed in the Light of Truth, which is the food of the Soul, mixed with incredible Delight: I ſhall deſire that they will deal ſo fairly with me, as not out of their fond Curioſity to nibble upon the Twigs and utmoſt Branches; but let them do their worſt ſtriks at the Root or Body of the Tree, or at leaſt-wiſe ſome of the principal Limbs thereof: In the mean ſpace, I have no more to ſay but this; Whoſoever thou art that readeſt this Diſcourſe, where thou art aſſured, go on with me; where thou art in doubt, ſearch with me; where thou doſt acknowledge thy Error, recall me. Some per chance will conceive, that in writing ſuch ſecrets and wonderful Subjects, ſomething may be amiſs, ſome things may ſeem ſuperfluous or impertinent, although the dreadfulleſt Cynick *or* Critick *of them all, cannot call them unprofitable or unpleaſant: The pains is mine, and if it be over done, done I am ſure it is; If I have (in ſome mens Opinions) ſaid more than enough, the wiſer and experter ſort of men will think that there is but enough ſaid to ſerve the turn.*

The

The Resolver of Curiosities, a no less admirable then profitable Discourse of Local, as also of the Swift Motion of the Art of Navigation, of the due proportion to be Observed in Building of Ships, of the Artificial Inventions of several Engins; with a perfect discovery of other admirable Mathematical Secrets.

AFTER the Art of Navigation was found, every man began to challenge to himself the Dominion of the Sea, and to make War as on the Land.

Minos (as *Strabo* writes) first found out the Art of Navigation, and was thereof (as writeth *Diodorus Siculus*) appointed by *Saturnus* to be Admiral of the *Navy*: and therefore the posterity afterwards ascribed to him the government of the Sea, and named him the God thereof. But most bestow this honour upon *Neptunus*. After whom the *Cretenses* were ever esteemed most expert in this Art. But (as *Pliny* writes) Boats were first Invented, and in them was the first Sayling in the Islands of the Red-Sea, under King *Erythra*. As also *Quintilius* witnesseth, saying, If none had proceeded further then our Predecessors, we had nothing in the Poets above *Andronicus*, and nothing in the Histories above some peculier Chronicles of the Ancients, and we had yet have Sayled in Troughes or in Boats. Others have ascribed this Invention to divers of other Nations and Persons: as to the *Troians* and *Mysians* in *Hellespont*: some write that the Ancient *Britains* made Boats of Leather or Hydes, and sayled with them in the Ocean. *Pliny* writes that *Danus* was the first that brought a Ship into *Argos* out of *Greece*. Some also give this honour to *Minerva*. But most rightfully, the Invention both of the Ship and the Art of Navigation,

is

is aſcribed to *Noah*, who (as writeth *Euſebius*) was long before *Neptune* or *Danus*. For doubtleſs (ſaith he) the Ark of *Noah* was none other then a Ship, and the firſt and only exemplar of the building of all other Ships or Veſſels of Sayling. Alſo the moſt Ancient writer *Beroſus* the *Chaldean* (as writeth *Joſephus*) calleth the Ark of *Noah* a Ship. The ſame *Joſephus* alſo ſaith, that the Nephews of *Noah*, departing to Inhabit divers parts of the World, uſed many Ships, &c. Long after *Noah* the *Tyrians* were counted expert in the Art of Navigation: and after them, divers other Nations. For whereas no Art is ſo perfect, but may receive increaſe, therefore it follows that this Art hath been greatly augmented and brought to further perfection by the witty Inventions of Poſterity, even unto our Age. And amongſt all other curious Inventions pertaining to Ships, the Marriners Compaſs is moſt admirable. Some notwithſtanding have been found, who have thought this Invention Ancient. *Levinus Lemnius* in his Third Book and fourth Chapter *de occultis Naturæ Miraculis* ſeems to doubt of it. *An hoc Inſtrumentum Nauticum Miraculis ſuperioribus ſeculis extitit, an noſtro id ævo excogitatum*: whether this Inſtrument of Navigation were in being in former Ages, or found out in later times, I cannot certainly define. Now that which chiefly cauſeth them to make a doubt thereof, is thoſe words of *Plautus*, *Hic ventus nunc ſecundus eſt, cape modo verſoriam*: where, by *Verſoriam*, *Lemnius* would have us to underſtand the Marriners Compaſs, and then adds, *quanquam ut Opinor hoc pixidicula noſtro jam tempore magis excultæ ſit, Elimata, Expolita, omnique additus ornamento*, as in the ſame Chapter he ſpeaks of Printing. But for *Plautus* I dare ſay he was never guilty of ſuch a meaning: *Turnebus* by *Verſoriam* underſtanding the Rope with the Sayl, others the Rudder, with which the Ship is turned: neither of which are impertinent or improbable, ſo as there is no neceſſi-

ty

ty of applying it to the Mrriners Compaſs. *Stephen Paſquier* in his 4th Book and 23th Chapter of his Recherches of *France* brings it up as high as the times of St. *Lewis* by the Verſes of one *Hugh de Bercy*, who lived in his Reign, and as he pretends plainly deſcribes it; but whether the words are ſo plain as he makes them, or whether they were publiſhed by ſome other ſince *Bercy*, but in his Name, is very uncertain, eſpecially ſince no Poet or Hiſtoriographer contemporary with him, or more Ancient then he, are found to make mention thereof; and yet *Lewis* dyed not much above 300 years ſince. *Pineda* the *Spaniard* in his Lib. 4th *de rebus Solomonis* for the more commodious placing of Tharſhes in *Spain*, is confident that it was in *Solomons* time, making his univerſal wiſdom and deep inſight into the nature of all things, the principal ground of his opinion: But *Solomons* wiſdom though it were univerſal and deep, beyond all the Children of the Eaſt, inſomuch, as God gave him *Latitudinem cordis*, a large Heart, as the Sand on the Sea ſhore, yet was it finite and limited as well in things natural as ſupernatural. I doubt not but *Adam* in the State of his Integrity knew more then *Solomon*, and yet I dare not pronounce him Omniſcious, that being an attribute (as is likewiſe Omnipotencie, Ubiquity, and Eternity) individually proper to the Godhead, and incommunicable to any created ſubſtance, though mearly incorporeal, whether they be the damned or the bleſſed Spirits. If then the Holy Angles, if *Adam* in Paradiſe knew not all things; nay, if the Son of God himſelf, as he was Man, confeſſeth himſelf to be Ignorant of ſome things, why ſhould we then think it ſtrange to affirm, that *Solomon* knew not all things. If there be ſuch a ſecret as the Artificial Tranſmutation of other Mettals into Gold, (which by the experiments of many is confidently avouched) it is more then probable that he was Ignorant of it; for had he knew it, he needed not to have ſent his

Navy

Navy to *Ophir* or *Tharshis* for Gold; as likewise had he known the secret of the Loadstone, his Navy needed not to have spent three years in going and coming, neither should his Marriners have needed to have craved the assistance of the *Tyrians* and *Sydonians*, as Pilots for the better conducting of them in their Voyage. I conclude then that either *Solomon* knew not this secret, or if he knew it he put it not into practice, or if he put it in practice, it was since lost and recovered again, which to me seemeth the strangest of all.

Now to the Authority of these three, who plead for the Antiquity of this Invention, may be opposed thirteen, and those in Learning nothing inferious, maintaining it to have been an Invention of latter Ages, unknown to the Ancients, as *Acosta*, *Mariana*, *Maluenda*, *Gomara*, *Turnebus*, *Pancirollus*, *Salmuth*, *Lillius*, *Giraldus*, *Cardan*, *Bozius*, *Bodin*, *Remus*. And to these might be added many more, were I ambitious in mustering up of Names, or did the cause require it. For questionless this our Age may not only seem to contend with the Ancients, but also for many goodly Inventions of Art and Wit, do far exceed them, not to speak of all the marvelous Inventions of our times (as we have already discoursed of the Marriners Compass) much also might be said of the invention of Printing, and making of Guns, Fire-works, and of sundry Artificial Fires, of such marvelous force that Mountains of most hard Rocks and Stones are not able to resist their violence, that neither the Spirit of *Demogorgon*, or the Thunderbolt of Infernal *Pluto* can do the like. What should I here speak of the wonderful Inventions of *Fatalia* in his Book *de Arte Majori*: or of any other whereof *Vanucius Peringocius* writheth in his Book Intituled *Pyrotechnie*. As touching which terrible inventions, and the like, although men are of Opinion that they were Invented by the Instigation of the Devil, for the destruction of Mankind: yet others weiging

the

the matter more indifferently, think that the Invention of Guns hath been the occasion of the saving of many mens Lives, because before the Invention and Use of them, men were wont to lye a long time a battering of Walls, Towns, Castles, but in short time it comes to hand, stroakes, with which the *Aries*, *Onager*, *Catapulta*, or *Balistæ*, Engines of the Ancients) which I know not very well how to English, they being grown for the most part out of use) are no way comparable, *nec ulla ex parte, huic conferendus est antiquus Aries, veres inferiores habebat, et difficilius ad muros adigebat*, saith *Patricius*, the Ram anciently for Batterie, is in no sort to be compared with this Engin, it hath less strength, and more difficulty there was in bringing it, and applying of it to the Walls: And *Bodin* in the like purpose, (though herein perhaps he jump not with *Lipsius* in his *Poliorcetica*) *omitto Catapultæ Veterum et antiquæ belli tormenta, quæ si cum nostris conferantur sane puerilia quædam Ludricra videri possint*: I pas over the Engines of the Ancients, which being compared with ours, are rather Childish toys then Instruments for War. And *Lipsius* himself calls it, *Genium, non bominum inventum*, an Invention of Spirits and not of Men. Such is the force (as we have in part said) of these Modern Engines, that they not only destroy Men, but cast down Walls, Ramparts, Towers, Castles, Cities, and shake the Tallest Ships into shivers, there being nothing that comes within their reach that can stand them. It was a piece almost of Incredible bigness, which by *Mahomets* command was imployed against *Constantinople*, *ad quem trahendum adhibentur septuaginta juga boum, et bis mille viri*, as witnesseth *Chalcondilus* in his Eighth Book *de Rebus Turcicis*, for the drawing of which were imployed seventy Yoake of Oxen, and two Thousand Men. It is true there is nothing more mischievous to Besieged Cities, and so there is nothing that helps them more for the chasing away of the Besiegers; it being so for

the

the moſt part in all things, which either the Art or Wit of man, or God and Nature hath framed, that the more helpful they are being well uſed, the more hurtful are they being abuſed: then Fire and Water there are no things more commodious to the Life of Man, yet is the Proverb true, that when they are once inraged, and paſs their bounds, they become Mercileſs, Good Servants, but bad Maſters. The Tongue is ſaid by *Æſop* to be the beſt and worſt Meat that comes to the Market: for with it we both bleſs God and curſe Men, ſaith St. *James*. And Iron by *Pliny* is rightly termed, *Optimum, peſſimumq; vitæ inſtrumentum*, the beſt and worſt Inſtrument belonging to Man. But ſure it is that God in his Providence hath reſerved this Engine for theſe times, that by the cruel Force and terrible Roaring of it, Men might the rather be deterred from aſſaulting one another in Warlike and Hoſtile manner; I am of Opinion (as I have already expreſſed) that ſince the invention and uſe thereof, fewer have been ſlain in the Wars then before. Neither doth it ſerve (as is commonly objected) to make Men Cowards, but rather hardens them. For he that dares preſent himſelf to the Mouth of a Cannon, cannot fear the Face of Death in whatſoever ſhape it preſent it ſelf.

Howſoever ſome have not been wanting, who would bear us in hand that this Invention is not of Latter times, but Ancient; among whom *Sir Walter Raleigh* is one, who in his Hiſtory of the World, *Lib.* 1. *Sect.* 7. refers not only the Invention of Printing, but of Guns too, and Ordinance of Batterie to the *Indians*, grounding himſelf herein upon the report of the *Portugals*: and hereby, ſaith he, we are now made to underſtand, that the place of *Philoſtratus* in *Vita Apolony Tianei*, is no Fable, though expreſſed in Fabulous words, when he ſaith, that the Wiſemen which dwell between *Hyphaſis* and *Ganges* uſe not themſelves to go forth to Battle, but that they drive away their Enemies with Thunder and Light-

Lightning. But herein I can say nothing, chooſing with *Camerarius*, *potius credere quàm cum moleſtia experiri*, rather to believe it, then to endure the hazzard and trouble of it to make the tryal of it. Others refer it to *Salmoneus*, as witneſſeth *Levinius*, induced thereunto by theſe Verſes of *Virgil Aneid.* 5.

Vidi & crudeles, dantem Salmonea *pœnas,*
Dum flammas Jovis, *& ſonitus imitatur Olympi.*
Quatuor hic invectus, equis ac Lampada quaſſans,
Per Graium *populos, mediaque per* Elidis *urbem*
Ibat Ovans; divum ſibi poſcebat Honores
Demens qui Nimbos, & non imitabile fulmen,
Ære & Cornipedum curſu ſimulabat equorum.

I ſaw *Salmoneus* there endure
Moſt cruel Pains, and great;
For that he dared the Flames of *Jove*,
And Thunder counterfeit.
In Chariot drawn with Horſes four,
Shaking a fiery brand
Through midſt of *Elis* Town he rode,
And through all *Grecian* Land
Triumphing wiſe: and to himſelf
Audaciouſly did take
Honours Divine. Mad frantick man
That did not inlye quake;
With Horn-foot-Horſes, and braſs Wheels
Joves Thunders emulate,
And Lightnings impoſſible
For man to imitate.

But *Servius* in his Commentaries concieves, that this imitation of Thunder was by driving his Chariot over

over a brazen Bridge; and if he uſed an Engine, it ſeems to have been rather for Ratling and Terror, then for any real Effect. And whereas great Ordinance exceed Thunder, this was ſuch that it came far ſhort of it; And therefore as *Rota* hath well expreſſed, the Poet calls it.

non imitabile fulmen.

But this I leave as a very uncertain ground for the ancient Invention of this Engine. *Petarch* and *Valturius* upon better ſhew of reaſon (as they conceive) refer it to *Archimedes*, found out (as they pretend) by him for the overthrow of *Marcellus* Shippes at *Syracuſe* Siege. But it were ſtrange that both *Plutarch* and *Livy*, who have written largely of his admirable Wit and wonderful Engines; and particularly of the Siege of that City, ſhould among the reſt forget this rare Invention, and yet more ſtrange, that the *Romans* upon the taking of the City, ſhould not take it up and make uſe of it: Nay, as *Mugius* (who hath written a Chapter to this purpoſe, to refute them who refer this Invention to the Ancients) hath obſerved; neither *Heron*, nor *Pappus*, nor *Athenæus*, nor *Biton* in their Manuſcripts of the *Mechanicks* (for printed they are not) have deſcribed any ſuch Engines, nor *Egidius Romanus*, (who lived and wrote in the Reign of *Philip* the fair King of *France*) about the year 1285) where he treats purpoſely of Warlike Engines and Inſtruments: yet remembers not any ſuch thing. *Brightman* in his Expoſition on the Revelation of St. *John*, tells us that by the Fire, and Smoak, and Brimſtone which in that place are ſaid to have iſſued out of the Mouths of the Horſes, are to be underſtood, our Powder and Guns now in uſe, and that of them St. *John* propheſied, But how theſe are ſaid to iſſue out of the Mouths of Horſes

ſes, he doth not well expreſs, nor I think well underſtood.

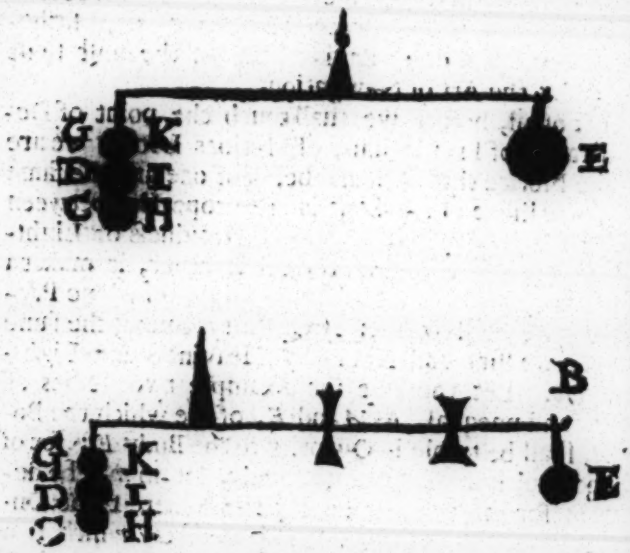
The Common Opinion then is, that this device was firſt found out by a Monk of *Germany*, whoſe name many Writers affirm to be deſervedly loſt; but *Forcatulus* in his fourth book of the Empire and Phyloſophy of *France* names him *Bertbold Swartes* of *Cullen*, and *Salmuch Conſtantine Ankfitzen* of *Friburg*: Howſoever they all agree that he was a *German* Monk, and that by chance a ſpark of Fire falling into a pot of Niter, which he had prepared for Phyſick or Alchimy, and cauſing it to fly up, he thereupon made a Compoſition of Powder, with an Inſtrument of Braſs or Iron, and putting the fire to it found the Concluſion to anſwer his Expectation. The firſt publick uſe of Guns that we read of, was thought to be about the year 1380. as *Magius*, or 1400 as *Ramus*, in a battel betwixt the *Venetians* and *Genoways*, fought at *Clodia Foſſa*, in which the *Venetians* having from the Monk belike, gotten the uſe of Guns, ſo galled their Enemies, that they ſaw themſelves wounded and ſlain; and yet knew not by what means, nor how to prevent it, as *Platina* witneſſeth in the Life of *Urbane* the ſixth. And *Leualla* in his ſecond Book and 34th chapter of his Elegancies, (which as himſelf teſtifies) he wrote in the year 1438. ſays that the Gun grew in uſe not long before his time: his Words are; *Nuper inventa eſt Machina quam Bombardum vocant*, The Engine which they call the Gun was lately found out. And *Petarch* who lived ſome time before him to the like purpoſe in his 99th Dialogue of his Remedies of both Fortunes, though therein I confeſs he ſeem to croſs himſelf, *Erat, hac peſtis nuper rara, ut cum ingenti Miraculo cerneretur*: This peſtilent device was lately ſo rare, that it was beheld with marvellous great Aſtoniſhment. Yet I have ſeen the Copy of a Record, that great Ordinance were brought by the *French* to the battery of a Caſtle

or Fort called *Outhwyke*, near to *Callice*, and then in the poſſeſſion of the *Engliſh*, the firſt year of *Richard* the Second; of which Fort, one *William Weſton* was Captain, and being queſtioned in Parliament for yielding up the Fort, he did in his excuſe alledge, that the Enemies brought to the Battery thereof, nine pieces *des groſſes Canons, par les quelles, les mures*, & *les Meaſons da dit Chaſtel, Funes rentes, & percuſſes en pluſieus Lieux*, of great Canons, by means whereof the Walls and Houſes of the ſaid Caſtle were in divers places rent in ſunder, & ſorely battered; and in another place he termeth them huge moſt grievous, & admirable Ordinance; nay more then ſo, I am credibly informed, that a Commiſſion is to be ſeen for making of *Salt-Peter* in *Edward* the thirds time, and another Record of Ordinance uſed at that time, ſome twenty years before his Death; by all which it ſhould appear, that either the Invention of Guns was ſooner than it was commonly conceived, or that our Nation and the *French* had the uſe of it with the firſt: Howſoever it is moſt clear, that at leaſt-wiſe in theſe parts of the World, this Invention was not known till in latter Ages. But to continue our diſcourſe of Engines and ingenious Inventions, uſed and invented for the Glory of God, againſt the Tyranny of *Turks* and Infidels, for the Defence of his People; we may rightly ſay of them, that they were the Gifts of God, as were the Inventions or Art of them that either builded the Temple of *Jeruſalem*, or the *Ark of God*: And yet is it there written of theſe Artificers, that God gave them the Spirit of Knowledge and cunning in ſuch Arts. And therefore I think it may be alſo ſaid without offence, that the Knowledge of *Archimedes*, and other men of ſuch commendable Inventions, are the Gifts of God free, and not bound to any Nation or Perſon.

Beſon, that excellent Geometrician of our late times, who was maſter of the Engines to the *French* King, Publiſhed a book in Print, concerning the Forms and Pourtraicture of ſixty Engines of marvellous ſtrange and profitable device, for divers commodious and neceſſary uſes, of which foraſmuch as three of them, that is to ſay, the 54, 57, and 60. are Engines chiefly pertaining to Ships, I ſhall in their due place diſcourſe of them. My next deſign ſhall be to treat of the Proportions of Local Motions, wherein to the moſt expert in Learning, I ſhall ſhew the Errors of *Ariſtotle* by Words and Demonſtrations, and that modeſtly, for I repute *Ariſtotle* for the chief of Philoſophers. Yet for that it is humane to err, he alſo might ſometimes fail. In the handling of which Demonſtrations, I ſhall not ſo apply my ſelf to Philoſophers, as not to deſcend, ſo as to inform the Marriner, that he may learn many proper Conclusions from thence moſt neceſſary for his Knowledge, and afterwards proceed to other rare Mathematical Secrets of other Engines, and of the moſt ſwift Motion by the Art of Navigation.

Firſt of all, before we ſhall touch the point of Demonſtration of Proportions, of Motions Local, we are to take Notice that of Bodies being of one and the ſame kind, the like and ſelf-ſame is the proportion between Quantities, which is alſo between Heavineſs or Lightneſs, either ſimply or in reſpect to other, it maketh no matter it is enough, that among them whoſe Proportions we ſhall conſider by Quantity, among the ſame likewiſe we ſhall underſtand by Heavineſs and Lightneſs, *&c.* Let there be for Example two bodies of Lead, and unequal, As *A* and *E*, of the which the Body *A*, ſhall be triple in Quantity to the Body *E*; for of the Multiplications of the Body, let no man be deceived: for many have thought the Sphere to be Duplicate, when the Diameter is Duplicate, which is a great Error, as appeareth in the 15. of the 12th of

Euclide. For there is ſhewed that the Proportion of two ſpheres the one to the other, to be as it were the Triplicate Proportion of the Diameter of the greater Sphere, to the Diameter of the leſs; likewiſe alſo is ſhewed in the 37. of the 12th, of ſolid Bodies, Like and Equidiſtant Superficies. Furthermore, *Albertus Durerus* ſpeaketh ſufficiently of this in his 4. Book of *Geometry*, teaching the Duplication of *Cubus*, &c. For then the ſame Body *A*, ſhall exceed the Body *E*, in heavyneſs in triple Proportion. Note therefore the Weight *A*, and the Letter *B*, and *E*, be ſigned *F*. and conceive in mind the Body *A*. to be divided into three equal parts, that is to ſay, *C*, *D*, *G*, of the which parts, *H*, *I*, *K*. now is it manifeſt for the Preſuppoſition, that every part of *C*, *D*, *G*, in equality ſhall correſpond to the Body *E*. and ſhall weigh by common



Science

Science, equally *F.* which if it were not, every part of *A* ſhould not be reputed Homogeny, or all of one like ſubſtance with the Body *E*, and ſo ſhould it repugn with the preſuppoſed. Therefore, foraſmuch as *H*, *I*, *K*, together, is equivolent to *B*, only by common Science, ſhall be alſo (by the 7. of the 5th) *B*, to *F.* the ſame that is *H*, *I*, *K*, to the ſame *F.* but the Weight of *H*, *I*, *K*, is triple to *F.* by which reaſon the Propoſition is manifeſt.

I will now make Demonſtration how Bodies of the ſelf-ſame, or one kind and Figure, equal or unequal one to the other, in the ſame midſt or mean, by equal ſpace, be moved in one or ſelf-ſame time; the which is againſt *Ariſtotle*, and all other Philoſophers, that have not yet ſeen this Propoſition. *Ariſtotle* firſt, in the 4th of his *Phiſiken Gep. de Kacuo*, where he intendeth to ſhew, that if *Kanuum* or *Void* be granted, Moving or Motion, is taken away, &c. He there ſaith thus, *We ſee thoſe Bodies which have more Heavineſs or Lightneſs*; So that they be one Figure, to be more ſwiftly moved by equal ſpace, and by ſuch proportion as they have the one to the other. And therefore they are ſo moved *per Vacuum*, &c. which is proved to be falſe. Furthermore, what St. *Thomas Aquinas* ſaith touching this; any man that will, may read; for no man better underſtood the mind of *Ariſtotle*. But for the Examples, that *Simplicius* and *Averroes* give to the underſtanding of this (by two Spherical Bodies of equal Quantity, but of divers kinds, as one of Gold, and the other of Silver) we muſt not therefore ſay, that he underſtood this Propoſition as I will demonſtrate. For they ſhould have ſaid ſomwhat of the Equality of the Quantity of thoſe Bodies; foraſmuch as the Motion of Bodies, equal and unequal, is all one, ſo that they be all one Figure: As for Example, *If there be three Spherical Bodies, of the which two are of Gold, and the third Silver, and they of the Gold are unequal, and the other of Silver equal to one of the*

Golden Bodies; then in the ſame Proportion of time, ſhall be moved the Golden Body equal to that of Silver, with Silver Body, with the Golden uneqal, as ſhall be declared hereafter. Furthermore, 6 *Phiſick Cap.* 1. in the end, and in a manner through all the Chapter of the ſame Book, he confirmeth the ſame: but in the fourth he ſaith thus, whereas every thing that moveth, moveth in ſome other, and in ſome time, and that moveable is Motion of the whole, the ſame or all one ſhall be the Diviſions of the time and the moving, and of to be moved, and of that which is moved as alſo of that in the which is moving. Afterward he giveth Demonſtration after his manner, but *Cap.* 7. he willeth the ſame, where he intendeth, that infinite time, nothing may paſs into infinite greatneſs, *&c.* Furthermore *Ariſtotle* in his firſt Book, *de Calo*, confirmeth the ſame, ſaying ſimply, that the Reaſon or Conſideration of times, is contrary to the reaſon of weights; as if half a weight be moved in this time, the double is moved in the half of this, *&c.* And this *Cap.* 6, furthermore, *Cap.* 8. of the ſame Book he ſaith, the Fire in as much as it is greater then the Earth, ſo much the ſooner and ſwiftlyer it cometh to its reſting place, *&c.*

Alſo in his Second Book, *de Calo, Cap.* 8. he ſaith thus: As in other things, the greater Body is the more ſwiftly moved by his proper courſe or motion, even ſo alſo in the Heavenly Circles, and again *Cap.* 13. he affirmeth the ſame in two places, ſaying that the greater Earth, is ſwiftlyer moved.

Item, Lib. de Carlo Cap. 2. He ſaith thus, if according to the Proportion which hath the ſpace of *C D.* the Body of *B* ſhall be divided, all *B* in the ſame time ſhall be moved by *C E*, in the which time part of *B* by *C D* of neceſſity: Wherefore it followeth that *B* be moved by ſwifter Motion then part of *B*. Afterwards he maketh a like Demonſtration, ſaying thus, The ſwiftneſs of the leſs to the ſwiftneſs of the greater, hath ſuch Proportion

portions as the greater Body to the leſs, &c. Again in his 3d. Book *de Cælo cap.* 5. In the end of it he ſaith likewiſe, that ſo much the more every thing is moved, as it is the greater, as alſo the Fire, the greater it is, is ſo much of ſwifter Motion, &c. he confirmeth the ſame *cap.* 2. & 4*th.* of the ſame Book, where yet ſpeaking more clearly, he ſaith, That the greater Fire riſeth ſwiftlyer upwards than a leſs; and a greater piece of Gold or Lead, doth ſwiftlyer move downwards, and the like of heavyer Bodies; and more clearly can no man gather the meaning of *Ariſtotle*.

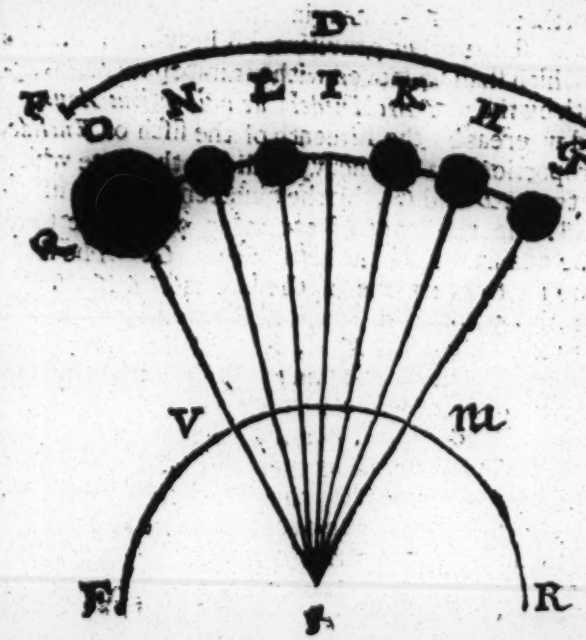
Vitelio, in his ſecond Book of *Perſpective*, in the ſecond Propoſition, hath fallen into the ſame Error. I pretermit his Ignorance in that Propoſition where he thinketh that there is no Quantity inſenſible: But let this paſs with other Errors, the which at another time ſhall be ſhewed in their place. He that will read other Philoſophers, ſhall ſee that they all accord with the mind and Sentence of *Ariſtotle*, who alſo in divers other places confirmeth the ſame: but to have Rehearſed theſe principal places, may ſuffice, and therefore we ſhall now come to the Demonſtration.

This propounded Demonſtration, I will ſhew apparently, that it may the better be underſtood, and foraſmuch as *Ariſtotle* in his work *De inſidentibus Aquæ*, hath ſpoken nothing of the Proportion of Motion of Elements, it is manifeſt that he hath not yet ſearched this Propoſition; for there was the proper place of this matter. But it is not granted to any one man to know all things: and therefore it was very difficult to many to imagine the Suppoſition, whereas *Archimedes* maketh none other Demonſtration, but that natural Motion is not cauſed of any other then of the Exceſs or proceeding of a Body in an Element, above or upon the ſaid Element.

The Demonstration

Let be for Example two Bodies, *G* and *O*, both alike (that is) Spherical and Homogenie (that is) altogether of like substance: of the which *O* shall exceed *G* in Quadruple Proportion, (for if it shall exceed it in Quantity, it shall also exceed in Heavinesse as is said before) and that the Mean or Middle be Uniform, as *B D F M V*. For Example; Let the termining Lines be Equidistant, & the same also circular upon the Center *S*, then by the termining Line, from whence, let pass or be drawn the Line *P I D*, and by the termining Line to whom let pass the Line *R M V T*. Thus I conclude, the Bodies *G* and *O* to be moved in equal time by the said space, by the Motion of Nature in the foresaid Mean: but if the body *O* were equal to the body *G*, there were no doubt, but that those bodies should be moved in equal time by the same space, &c. I will therefore by imagination divide the body *O* into four equal parts, like unto their whole: Let be therefore those parts signified by the Letters, *H K L N*. whose Centers (for Example) I will put in the Line *P O*, so that the distance betwixt *H* and *K*, by the same that is between *L N*. I will also divide the Line *K L*, by Equality, by the the 29 of the third of *Euclide* in the point *I*, which shall be the Center of the heavinesse of the bodies *H K*, and *L N*. by common Science maintained, by the third Proposition of the Book of *Archimedes, De centris granium*. Furthermore it is manifest, that every one of the Bodies, *H K L N*, shall be moved in equal time from the termining Line or space of *P I O*, to the termining Line *R V M T*, to that in which is *G*, passing together from and at the same instant, shall be moved equally, that is to say, in equal time, and ever the Line passing by their Centers, shall be

be distant to the Line *R M V T*. Finally if the Line be understood by the Center *I*, and the body *O* divided by Equality or equal Distance, then the point of Division, shall be the Center of the weight *H K L N* and *O*, by the aforesaid, but now if that Line be understood to be moved by the force of the aforesaid bodies, and Demissed from the Line *P O*, or equidistant to it, for then also should *M V R T*. be equidistant by common Sense; *M V R T*, and the body *O*, in equal time by the motion of Nature, shall be moved by the granted space, to that in the which the bodies *H K L N*, shall be moved for distance of the Mean to the bodies *H K L N*, is the same which is to the body *O*. But that this may appear,

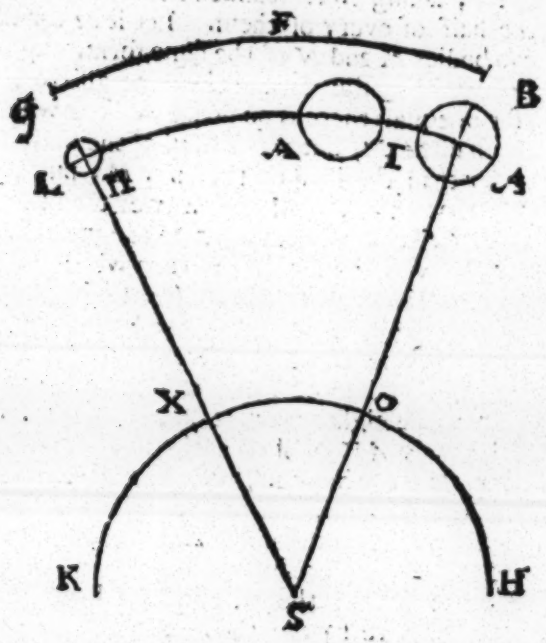


Let it be thus underſtood. Let us imagine (for example) two bodies of Water: of which, the one ſhall be equal to the body *O*, and the other to the body *G*, or to one of the bodies *N L K H*, which ſhall be all one: then ſixteen of the fift, the proportion of *O* to *G*, or one of the aforeſaid bodies, is the ſame which is of the waterie equal *O*, to the waterie equal *G*, by the propoſition declared before. The proportion of the waterie body equal *O*, the heavineſs of the watery body equal *G*, is the ſame which is between the quantities of the ſelf ſame bodies: but we muſt underſtand them to be ſuſteined or weighed in a rarer or thinner Element. The proportion thereof ſhall be the ſame which ſhall be between the proportion of bodies *D* and *G*, by the eleventh of the fift; the aforeſaid proportion being thereto. Furthermore let us imagine the heavineſs of bodies, *O* and *G*, ſo the other gravities and heavineſs, ſhall be thoſe which ſhall be moved without impediment, as appeareth by the 7 of *Archimedes*, *de inſidentibus Aquæ*.

And whereas by the fifteenth of the fifth of *Euclide*, the proportion of theſe heavy bodies is the ſame which is betweene *D* and *G*, by the nineteenth of the fift aforeſaid: the reſiſtance of the mean or middle to *D* ſhall be quadruple to the reſiſtance of *G*. The ſame alſo do I ſay to every one of the bodies *N L K H*. It appeareth by common Science, that reſiſtance of the mean to the bodies *N L K H*, is equal to that which is to the body *D*, but is the ſame to which *G* by the firſt conception of *Euclide*. Furthermore, if there be two bodies all of one figure, but of divers homogeneite or ſubſtance, and of unequal corporality, and (for example) either of them heavier than the mean or the middle, in the which they are moved, and that alſo the leſſer of them be heavier then the bigger, yet that the greater weigh more then the leſs, then I ſay, that the leſs ſhall be ſwifter in motion: and the ſame ſhall be the proportion of time to the leſs, which is to the greater,

which

which is alſo the greater kind of heavineſs to the kind of the leſs, taking away ſo much heavineſs from both, as is the half of every of them. Let it be for Example, two bodies *M* and *N* of the ſame form, and divers homogeneite or ſubſtance, and the ſame alſo to be unequal (for of equals there is no doubt) of the which the greater ſhall be *M*, but of the kind of the body *N*, to be heavier than the kind of the body *M*; putting the caſe alſo, that the body *M*, be heavier than the body *N*, and each of them all heavier than the mean or middle body, by which they move, then will I ſhew the proportion. Underſtand firſt *AVF* to be equal and like figure to the body *M*, but of the kind of the body *N*. Let's imagine alſo that the body *M* in heavineſs, to exceed the middle or mean in double proportion *AVF*, or in the eighth proportion: ſo then the moving of the body *AVF*, ſhall in the ſeveth proportion be ſwifter then the body *M*, becauſe the reſiſtance of the body *M* is *ſubdupla*, and to the body *AVF* is *ſuboctupla*, by the ſeventh of *Archimedes de inſidentibus Aquæ*. But by the aforeſaid demonſtration, the body *M* ſhall be moved in the ſame time which the body *AVI*. Wherefore by the the firſt conception of the mind added upon *Euclide* by *Companus*, the propoſition is clear.



The like reaſon is alſo of violent motions, taking the proportion of the moving ſtrengths, and taking away the proportion of the half or middle. Alſo, whereas are two equal Angles about the Horizon, or under, but in contrary motion of Nature, becauſe violent motion is ſwifter in the begining than in the end, and the contrary chanceth in the motion of Nature: for with violent motion, the motion of Nature is ever ſomewhat mixt, if Horizontically or Angulerly it ſhall be above or beneath the Horizon; and Nature worketh ſo much, until it bring violent motion to ſome end. But if the Perpendicularly Violence ſhall be made about the Horizon, and towards the place which that body naturally mov-

moveth unto, then Nature cannot ſtrive againſt or withſtand, but that Violence doth ever go with it, in reſpect of the end from whence. Furthermore, by the aforeſaid, it is manifeſt, that to be falſe which *Ariſtotle* ſaith 7 *Phiſic.* in the laſt Chapter, where he ſaith, if *A* be that which moveth *B*, and *B* that which is moved, and *C* the Longitude whereby, and *D* in which the motion is, that is to ſay, in equal time and power equal. *A* the half of *B*, ſhall move by the double of *C*, and *C* in the half of *D*, for ſo ſhall be the ſimilitude of the reaſon, *&c.* That it is falſe I will thus demonſtrate. Let us firſt imagine two bodies as before, in any mean or middle homogenie, *&c.* And let us for example, *M* and *N*, and that *M* be double in quantity to the Body *N*, and that the weigt of *N* be with one of the weight of *M*; and alſo that the body *A V I*, be equal to the body *M* in quantity, and in likeneſs or kind of the body *N*; then by common Science, the body of *A V I* ſhall be double in heavineſs to the body *M*. And granting that the body *M* by double in heavineſs above the half, then ſhall the body *A V I* be quathruple in heavineſs above the ſaid half. Wherefore the reſiſtance taken away, let be left the time in which the body *A V I* be quadruple in heavineſs above the ſaid half. Wherefore the reſiſtance taken away, let be left the time in which the body *A V I* in the ſame time ſhall be moved the body *N*, by the aforeſaid. Or if in the ſame time the body *N*, ſhall be moved with the body *M*, yet the ſpace by which *N* ſhall be triple to that by which *M*, for the reaſons are all one of violent motions. The ſame ſhall preciſely come to paſs, if inſtead of the exceſs of weight above the half, we ſhall take the virtue or power of moving, *&c.* as before.

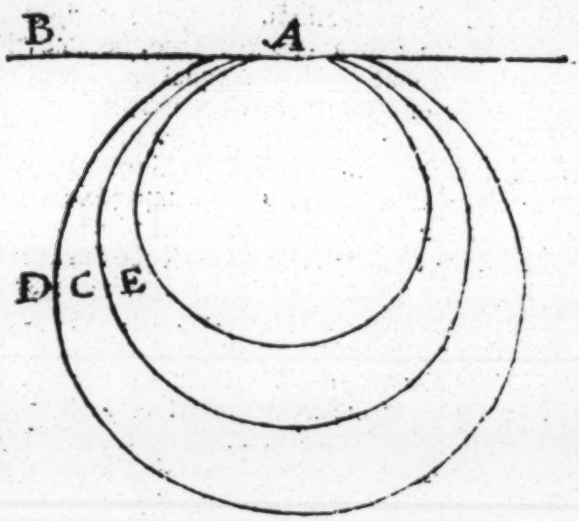
Ariſtotle likewiſe erreth in his 4 *Phyſic.* Chap. 8. Where he diſcourſes *de Vacue*, ſaying that the ſame, or elſe all one, ſhall be the proportion of motions of any body by divers Elements, As if the Air be in ſubtilty

double

double to the water, in double time *B*. The mean ſhall paſs to that time, in which by the mean *D* and *C*, the time ſhall be double of the time *E* and *C*. Now to ſhew the Error of *Ariſtotle*, let us firſt underſtand, a body to paſs through Water by natural motion, as (for example) by a granted ſpace, let us alſo imagine that body in double to exceed the water in the weight, and that the Water in heavineſs exceed the Air in double proportion, then the granted body ſhall be quadruple to the Air. Wherfore in the havineſs the reſiſtance of time taken away, in the which the motion of that body in the Air, by equal ſpace to that, by the which in Water to the time wherein by Water in the granted ſpace is moved, the proportion ſhall be ſubtriple, and not ſubduple, as *Ariſtotle* affirmeth. *Ariſtotle* alſo erreth in the ſame Chapter, ſuppoſing that if motion ſhould be granted in voide, the ſame or all one, ſhould be the reaſon of time to time, as is between moving bodies, which is impoſſible by the aforeſaid. For thoſe bodies ſhould be moved in equal time, although they ſhould be of divers kinds, forms and bigneſs. By which place alſo is eaſie to gather, that the mind of *Ariſtotle* was, that the proportion of motion to motion, is the ſame thing which greatneſſes have between them, according to the heavineſs and lightneſs ſimply. But that this alſo may the more clearly be underſtood, imagine the bodies *M* and *N* in void, and that the body *N* be of the ſame weight which *A V I*, but of divers kinds, and conſequently of divers bigneſs: then whereas thoſe bodies have no reſiſtance, there is no doubt but that they ſhall be moved by equal time, by equal ſpace. I will take therefore the body *A V I*, of the kind of the body *N*, but of quantity of the body *M*. Now then by the mean of the true method of the demonſtration before ſhewed *A V I*, and *N* ſhall be moved in equal time with the body, *N* by equal ſpace. Wherefore, by the firſt conception in the ſame in the *M*, wherefore it followeth, &c.

Further-

Furthermore alſo where *Ariſtotle* 7. *Phiſic.* ſpeaketh of the compariſon of motions, ſaying that a right Line is not comparable to a crooked Line, becauſe there ſhould be found ſome right Line equal of circuler Line, either greater or leſs. For whereas by reaſon of the definition given by him in the 6 *Phiſic.* to the ſwiftneſs and ſlowneſs of motion, it ſeemeth to him that it cannot be, that circular motion ſhould be comparable to right motion. In the which he is manifeſtly deceived, and chiefly thinking that a right Line cannot be found equal, greater or leſſer to the circular Line: Whereas *Archimedes* in his firſt propoſition in *Geometry*, ſheweth the contrary, and that by Mathematical demonſtration, and not by the opinion of *Ariſtotle*. For *Archimedes* ſheweth there, by what means we may find a right Line greater or leſs then any circular Line, conſtituting figures of right Lines, without or within the circle, *&c.* But ſome men may ſay, that though a right Line may be granted greater or leſs than any circular line, yet that the ſame cannot be found equal, whereas in the fifteenth of *Euclide* the third is ſhewed, that a greater Angle may be found, then is the Angle of a Contingence, and that by the motion of the right Line of the greater Angle, paſſage is made to the right Line contingent or touching the circle: yet that it cannot be that with the contigent Line it ſhould make an Angle equal to the Angle of Contigence. To this I anſwer, that although a greater Angle be granted, yet not a leſs: for if the leſs ſhould be granted as well as the greater, we ſhould likewiſe have an equal.



For Example, conſider the circle *A C*, with the Line *A B*, doth touch in the point *A*. The Angle of contingence ſhall be *A B C*, then let the circle inwardly deſcribed *A E*, touching the circle *A C*, in the point *A*, for to one only point it ſhall touch the circle *A C*, by twelve of the third. And ſo the Line *A B*, ſhall touch the circle *A E*, by common Science, by the which the Angle *B A E* ſhall be greater than the Angle *B A C*. Likewiſe alſo, if the circle *A D* ſhall be deſcribed outwardly, the Angle *B A D* ſhould be leſs than the Angle *B A C*. And conſequently by the ſame order whereby we make the greater or the leſs, we ſhall alſo conſtitute equal, which is the leſs.

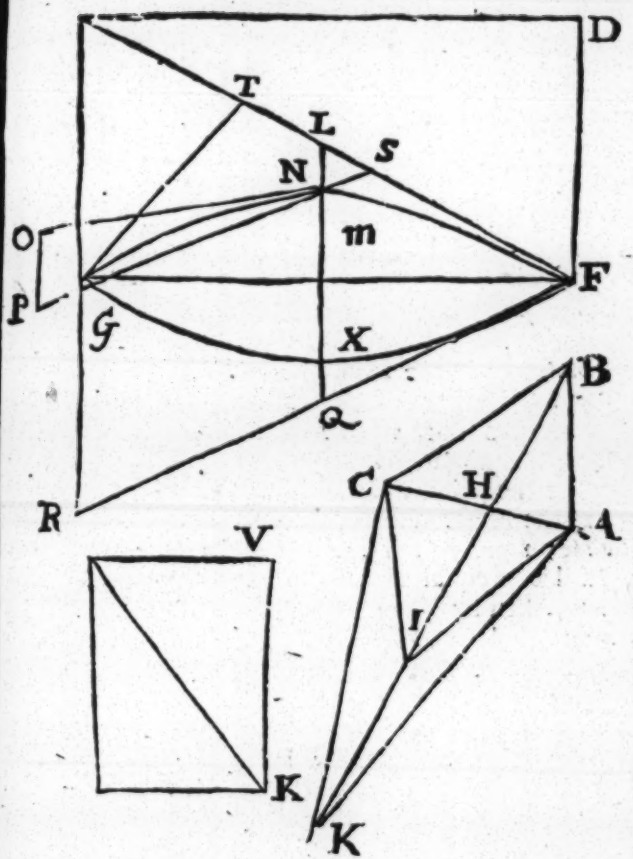
Wherefore it followeth, that it may be done contrary to that which *Ariſtotle* ſaith, and for the ſame ſentence of *Ariſtotle*, ſome have thought that it is impoſſible for any of the figures of crooked Lines, ſhould be found

fraud equal to any figure of a right Line, or the contrary, the which to be impossible I will demonstrate. For Example, let be given a Trigon, I mean also of all figures of right Lines, for as much as they shall be divisible into Triangles, as appeareth by the thirty-second of the first. And of these Triangles we shall constitute a superficial Line of equidistant sides, by forty-four of the first. Taken as often as need shall be, which duplicate by the helps of thirty-six of the first, and afterwards a Diameter in it, then the half of the superficies shall have an equal Triangle of the taken superficies of the forty-one of the first, or by the taken right Line by the first conception, I will constitute a superficial of two crooked Lines continued equal unto it. I will divide the first Basis or ground *A C* by equal spaces into points *H* by ten of the first, and I draw *B H*, which also I draw forth untill *H K* by double to *BH* by 3 of the first assumpted. Then to the half of *H K*. Thus is *I*, I direct *CI* and *AI*; I joyn thereto also *AK* and *CK*, by right Lines: then (by the first of the sixt) these Triangles shall be all equal to themselves. After this, I will constitute a superficial of equidistant sides, and of right Angles upon whatsoever Line, which superficies shall be equal to the Poligonie *ABCK*, by 44 of the first assumpted, as often as shall be needful, that superficies is made *GD*. But in the which I draw the Diameter *FE*, so that by 41 of the whole Trigon *F G E*, shall be the half of the whole superficies, and by common science equal to the Tigon *BKC*, and Triplus to the Trigon *BHC*. Now I divide *FG* by equal in the point *M* by 10 of the first. So do I also of the Line *ML*, dividing it by equal in the point *N*, by the aforesaid 10 of the first. Afterwards by 44 of the first twice assumpted of equidistant sides, I make a superficies of right Angles upon the Line *M*, *N* equal to the quadrature of the Line *FM*, traverse or overthwart, and *ND* right, I constitute a Parabol of a right Angle, that it may be

of

of leſs labour: for this Example may ſuffice of by 52 of the firſt of *Apolonius Pergeus*, the Termining Line of which Parabol, ſhall paſs by the points of *FN*, and *G* by the ſame and by 33 of the ſame *FE* ſhall touch the Parabol at the point *F*. And afterwards when the Trigon *FEG* ſhall be triplus, to the Trigon *BHC*, as we have ſhewed before, but alſo the portion of *FNG*, triplus by the 17 of *Archimedes*, *de quadratura Paraboles*. Wherefore the portion *FNG* ſhall be equal to the Trigon *HBC*, by the firſt conception in *Euclide*, added by *Companus*. Furthermore, I draw *EG* untill by the third of the firſt *GR*. Equal *GR*. I draw forth alſo *FR*, and *LMO*, then by the fourth of the firſt Triangle, *FGE* ſhall be of equal ſides, and alſo of equal Angles to the Triangle *FGR*. Furthermore, *DM* is equidiſtant *GR*, by common ſcience, and by *RG* of the firſt, the Angle *FDM* equal to the Angle *FRG*, and the Angle of *FRG* equal to the Angle of *FMD*; and whereas the Angle of *FRG* is common to either of them, then by the four, of the ſix, the ſame, or all one, ſhall be the proportion of *RG*, to *DM*, as is of *GF*, to *MF*. But as is *GF*, to *MF*, ſo is *GF*, to *ML*. Wherefore by *N* of the firſt, *GF* hath it ſelf ſo to *MF*, as *GR* to *DM*. But by the 16 of the ſame *ML* to *DM*, hath it ſelf, and *GF* to *GR*. Wherefore *ML* equal *MQ*; which *MQ* I divide by equal in the the point *X*, by 10 of the firſt, and will do as before. Then by the reaſons aforeſaid of the ſame, the portion of *FXG*, ſhall be equal to the Trigon *ABH*, and the whole ſuperfiices *FGNX*, ſhall be equal to the whole Trigon, *ABC*, which is propoſed.

The



The contrary appeareth thus, Let be grated a ſuperficies, contained of two parallel lines, as *FNG*, and *FXG*, propoſing (for Example) to find a ſuperficial of right lines Trianguler equal to the granted ſuperficies. I draw firſt *FG*. Then afterwards by 44 of the ſecond of *Apolonius Pergeus*, I find the Diameter of the *Parabol FNG*, which is *MN*, which I draw to *ML*, to be equal *MN*.

MN. Then I draw *FL*, which ſhall touch the Parabol of *FNG* in the point *F* by 33 of the firſt of the ſame. then from the point *G*, I draw a line *GE*, equidiſtant from the Diameter *MNL*, by 31 of the firſt of *Euclide*: which I draw untill it joyn together with *FL*, the which doubtleſs ſhall be done by the ſecond of the firſt of *Vitellio*.

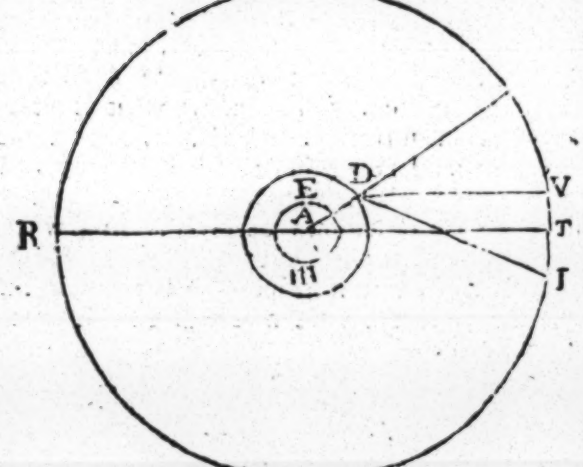
The Point of the Concourſe or joining together, is *E*, then I divide *F*, into three equal portions by the 11th of the ſixth of *Euclide*, in the points *S* & *T*, which points I join with the point *G*. by the Lines of *FG*, and *GR*. Now ſhall there be three Angles all equal to themſelves by the 38 of *Euclide*. After this, I conſtitute a *Trigon*, *BHC*, equal to the *Trigon*, *FSG*. by this means I draw forth *HC*, to the Equality of *GS*, by the Equality of the 4th of the firſt of *Euclide*. Then at the point *HI* deſign an Angle, *BHC*, equal to the Angle of *FSG*. by the 23d of the firſt of *Euclide*; and by 3. of the firſt of the ſame, I draw *HB*, until it be equal *FS*. Afterwards I join *BC*, by a Line, then by 4. of the firſt, the Triangle *BHC*, ſhall be equal to the Triangle *FSG*, and ſhall be equal to the Portion *FNG*, by the 17. of *Archimedes*, *de Quadratura Paraboliæ*, by the help of the firſt Conception of *Euclide*. I do the like of the Portion of *FGX*, to whom by an equal Triangle *OPK*, then I draw *PQ*, equally diſtant *OK* and *RV* equally diſtant *OP*, by 31 of the firſt of *Euclide*, then by 41. of the ſame *OPR* ſhall be half of the Superficies *OV*. Now then I ſomewhat portract *CH*, then upon *BH* I conſtitute a Superficial of equidiſtant ſides, having an Angle of *BHA*, by 44. of the firſt of *Euclide*, twice aſſumpt to the Diameter of the firſt Superficies, *APB*, then by 41. of the ſame by the firſt conception of the *Trigon ABC*, ſhall be equal of the Superficies *FGNX*. granted which is the intent. *Ariſtotle* (to ſay the Truth) was an excellent ſearcher of things, yet

I

I will not ſay as ſome ſay (which have never read the the Works of *Ariſtotle*, or underſtand them not) that every Word of *Ariſtotle*, is almoſt a Sentence; and that *Ariſtotle* was the God of Phyloſophers, and that he never erred in one Word, but was divine in all things. Such miſerable men, if they knew what it were to ſpeak with Demonſtration, and what by Experience to the Senſe, would never have ſaid ſuch things. For Senſe ſimply, in thoſe things which are not properly ſenſible, we are oftentimes deceived. And whereas we cannot perceive the Deception, by the Mean of that ſimple ſenſe, then it ſeemeth to us that the thing cannot be, and that it is not in very Deed as it appeareth to the ſenſe.

As for Example, who is he that thinking not a Reflex Form on the Superficial Water immovable, to be ſeen of the ſame greatneſs, as is by a right Longitude, by the mean of a Diaphane, gathered of a Radical Line incident and Reflex; whereas this is falſe by *G D*, of the 6 of *Vitellio*. For the Superfities of the Water is Spherical, as ſheweth *Ariſtotle*, 2 *de Cœlo*, *cap.* 4. But better *Archimedes* in the ſecond Propoſition, *De ſubſidentibus aquæ*. And therefore when any Star appeareth to us above the Horizon, yet is it not indeed as it appeareth by this Demonſtration. Let the Star be *I*, the Horizon *R A T*, the Earth *E A M*, whoſe Center is *A*, and the ſight *G*, the Vapours *O F*; then whereas the radical Line paſſing from any rare thin, or tranſparent in any tranſparent of more thickneſs, maketh a Perpendicular, by the 45. of the Second of *Vitellio*, it is manifeſt therefore that the Star *I*, to be ſeen by the Line *I D E*, which Line ſhall be crooked, becauſe that ſimple Air is thinner then Vapours, and Fire thinner then Air. Alſo the matter or ſubſtance of Heaven is thinner then Fire, by the 50. of the 10 of *Vitellio*.

Further-



Furthermore, the higher part of the Air is thinner then the lower part, the ſame I ſay alſo of Water and Fire (if we may call Fire the higheſt part of the body, and near unto the concavity of the Moon) and of every Superior part of Elements. And ſo the Star by the Line *D E*, ſeemeth to be above the Horizon, in the point *V*. But *Vitellio* alſo in his 10 Book, in the Propoſition 49. teacheth perſpectively, and how it may be inſtrumentally proved, how the Stars may be ſeen in the Horizon, without their proper places, by reaſon of Incurnation or crooking of the Beams, whereof it followeth that they do not Mathematically define the Horizon, which ſay it is the Terminer or ender of the ſight, and of the greateſt Circles of the Sphere, whereas by the Demonſtration before, the Circle ending of the ſight, is cutting the Sphere in two unequal Portions, and that the higher Portion be greater then the lower. For if the Horizon be the ender of the ſight,

and

and one of the greateſt Circles, then the Earth is not equally about the Center or middle of the World, or elſe the middle of the World is without the Earth. But if the Earth doth equally compaſs about the middle, *ergo*, the ender of the ſight is not of the greateſt Circles in the Sphere, or contrarity. Therefore if we ſhall ſee any Star above the ender of the ſight, we ſhould not therefore think it to be in the twelfth ſtation of Heaven (this is to be underſtood by reaſonable manner) for the Virtue of the Star appeareth chiefly in the great Circle (whoſe Pole is *Zenith*) paſſing by the 90 Degree of the Equinoctial, from the Interſection or dividing of the ſame with the Meridian toward the Eaſt. Furthermore, the difference between the ender of the ſight, and the greater Circle, is not only one Diameter of the Star, but of Degrees, which if it were not, we could by no means uſe the Propoſition 49 of *Vitellio*: and therefore it was no ſmall Error of them that ſaid that the Horizon is the ender of the ſight, and one of the greateſt Circles in the Sphere, and that ever the middle of Heaven appeareth unto us, for evermore then half appeareth unto us; for the Incurvation or crooking of the Beams. But he that will ſee more Examples of theſe things, let him read the 4th Book of *Vitellio*, and the Tenth, and in ſome parts the Second and 5th of the ſame, in all of which he ſhall ſee ſomewhat how eaſily we may be deceived by this ſenſe, but the like of other Senſes is not to be doubted. Therefore not without weak and ſlender judgment, they call *Ariſtotle* ſo Divine a Prince of Phyloſophy, and Divine *Peter Arches*, did very wiſely give Commendation to *Ariſtotle* proportionally and no further, but only to God; foraſmuch as it is humane to err, *Ariſtotle* alſo might ſometime fail.

We having thus throughly diſcourſed of Proportions Local, we ſhall now next fall upon the ſwift Motion by the Art of Navigation, which will occaſion us to traverſe many rare Mathematical Secrets. This

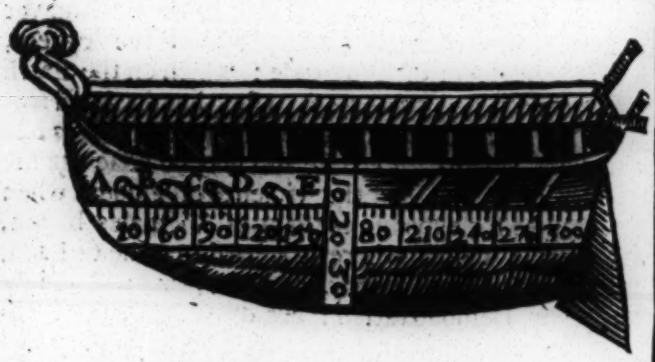
This moſt ſwift Motion to the common ſort of men ſeemeth incredible, for that the ſame may be done by ſailing in a Ship or other Veſſell, againſt whatſoever courſe of any Outragious Flood or River, and againſt the moſt furious Winds whatſoever they are, even alſo in the deepeſt Winter, and greateſt Sourges of Water. Neither is it ſtrange, if it be incredible to the unexpert. For the common people count that for a Miracle, which the expert Mathematicians know to be natural and eaſie: for if it ſhould be propounded to the ignorant people, that any man might in the midſt of the Waters and Floods, deſcend to the bottom of the River *Rhene*, his Apparel remaining dry, and no part of Body wet, and alſo to bring with him burning fire from the bottom of the Water, it ſhould ſeem to them to be ridiculous and an impoſſibility: Which nevertheleſs in the year 1538. in *Toleta* a City of *Spain*, in the moſt ſwift River *Tagus* (in which the Gold is ſaid to be found) running through the courſe of the Sun, none otherwiſe then *Danubius*, and three other in the World, making their courſe from the Weſt to the Eaſt, which ſtrange ſight twelve thouſand Perſons ſaw in the preſence of *Charles* the Emperour, the fifth of that Name. Of ſuch ſtrange Experiments I ſhall not need here to ſpeak much. Others there be that dare affirm, that a certain Ship was in ſuch ſort driven with violent Winds and furious Seas, with ſuch a ſwift courſe, that the Pilot ſtanding in the Keel of the Ship, near unto the Maſt, ſhooting an Arrow out of a Croſs-bow, the Arrow fell down before his Feet, and came not ſo far as the fore-part or fore-caſtle of the Ship. I have heard alſo of credible men, that a certain Pilot *Cantabrian*, lying at an Anchor at *Antwerp*, on a certain Sunday after morning Prayer, departed with full Sailes and proſperous Winds until he came to the Coaſt of St. *James* of *Compoſtella*, and immediately returning with like proſperous Winds came again to *Antwerp* in the ſame Ship

the

the *Sunday* next following. The which I deny not but may be done, yet not without great danger of Shipwrack, eſpecially in the return, the wind being at the South. Alſo in the year 1551. there was Experience made of a moſt ſwift Motion; For, from *Drepan* of *Sicilia* and *Trinacria*, the Port of the Gales of *Maltha* (now being in the place of the *Rhodes*, otherwiſe called of St. *John* in *Jeruſalem*) A certain Ship without ever ſtriking Sail, in 37 hours arrived at *Naples*. And yet are theſe places diſtant in Latitude almoſt five degrees, beſides ſome part of Longitude: which on the Earth correſpondeth and amounteth to four hundred and five Miles. The motions are cauſed by violent Floods and outragious Winds. The like alſo may be done againſt the fury of Winds and the violence of Floods, when need ſhall be for expedite carriage of Victuales by Sea, and even in places where it is hard to come to Land, and this with ſmall labour, as hereafter I will plainly declare by Demonſtration: but oftentimes, moſt expert Pilots and Sea-men do marvail that Sailing in Ships of the ſelf ſame making, weight, content, or capacity, framed alſo of the ſame Shipwright, furniſhed with equal Sails, and all other things appertaing, yet to be of ſuch diverſe ſwiftneſs, that the one cannot keep equal courſe with the other, which admiration doubtleſs muſt proceed through ſome ignorance or want of knowledge of the due proportion of the frame of all ſorts of Ships: that is the depth, bredth, height and length, (named by the Maſter Sea-men, Latitude, Longitude, Altitude and Profunditie) the which if they are unknown of the Maſter Carpenter or Shipwright, two Ships can never be ſo directed by equal courſe, but that one ſhall be ſwifter than another: and this doubtleſs only by reaſon of their different proportion in their framing, making, or architecture.

In the framing of any manner of Ship, the proportion of length, bredth, height and depth, ought moſt chiefly to

to be exactly obſerved, leaſt the ignorance or negligence of theſe conſiderations, ſhould hinder the ſwift courſe, and cauſe danger of Shipwrack. The due proportion of Ships moſt ſuppoſe to be, that firſt the Longitude or length of the Ship or Veſſel whatſoever it be more or leſs, ought to be divided into 300 equal parts, as appearetheth in the Figure following, of the which



parts 30 muſt be aſſigned to the height or depth, for the 10*th* part of the whole or length, and to the latitude or bredth ſhall correſpond the parts of the ſaid longitude 50, or the ſixth part of the Longitude. The Matter alſo or the Timber of ſuch a Ship muſt be light, leaſt too much heavineſs of the Matter ſhould hinder the ſwift courſe. And this proportion of Ships, or other Sailing Veſſels, of whatſoever ſhape or frame, is moſt convenient and no leſs neceſſary, for Sciffes, Ships of burthen, Galleys, double, triple, or quadruple (that is to ſay) of two, three, or four to an Oare. Alſo for *Toyſtes*, *Pinaces*, *Brigantines*, *Eſpions*, and ſuch lik.

I have oftentimes attempted by Mathematical reaſon, how and in what manner a commodious faſhion of Ships may be Invented with ſmall labour, and as little as may be of coſt, which may in ſhort time ſtrive againſt the

couſe

courſe of whatſoever ſtrong Floods or Rivers, as *Rhene*, *Danubie*, *Moſella*, *Scalda*, and infinite others of our own and other Countreys, boyling and overflowing through the abundance of great ſhowres, melted Snows and furious Winds, and this more eſpecially for the commodity of ſpeedy tranſporting of Victuals, and ſuch other neceſſaries: in conſideration whereof, the proportion firſt obſerved, and the ſaid Ship or Veſſel almoſt finiſhed, then muſt be made three holes from the Keele, towards the forecaſtle or foremoſt part of the Ship, as appeareth in the figure by the Letters *ABC*. In which holes, in time of the courſe, certain Engines of ſtrange and marvellous invention may be faſtened. In the poupe or hinder part of the Ship, may be prepared (after the manner of *Germany*) a little Stove or Hot-Houſe, where Paſſengers may commodiouſly reſt, now the Ship being thus prepared, the bottom thereof ſhould be dreſt with Tallow, and not with Tarr, that it may move the ſwiftlyer.

Thus having conſidered of the proportion and frame of the ſaid Ship, the reſt of the Mechanical or Handy-craft Work, we leave to the Carpenters and Ship-wrights.

It chanceth oftentimes, and that more eſpecially in Winter, that certain Floods and Rivers overflown with too much abundance of waters, do through their violence refuſe all Navigations that may be made againſt their courſe, to the great damage and hurt of the Inhabitants of many Towns and Cities, to the which they ſhould carry Victuals and other Proviſions, againſt the courſe of the Rivers: And therefore in favour of the Commonwealth, I have invented theſe kind of Ships, that I may hereby, as by my Seal, confirm the good will I bear to our poſterity. Now therefore it may ſuffice to have ſaid thus much of this ſwift motion which I have proved with my own ſtrength of reaſon, and ſufficiently declared the framing and uſe thereof: whereunto it may be eaſie for expert men to add more, ac-

cording to the excellency of their Wits and Cunning. For in all Sciences it is eaſier to add to Inventions, then to Invent. Let us now not only conſider what commodity this may bring to our ſelves, but alſo to the *Brabantines*, Sayling from *Antuerp* to *Bruxells* in the new River: for that which they attempt dangerouſly with great vexation and ſhogging in Wagons by foul and tedious Journeys, often wet to the Skin for the ſpace of a whole day, may by Water be done more conveniently, in the ſpace of four or five hours even againſt the River and Wind.

And leaſt the Reader ſhould ſeem to refute our ſayings, while he thinks that thoſe things which he eſteemeth for Miracles, to exceed the Limits of Nature, I will ſhew manifeſtly by one Demonſtration of the forementioned Enterpriſer, the manner how he deſcended to the bottom of the River, his body remaining dry as before I have affirmed. But here firſt let us conſider, that naturally the Water or Sea (as other Elements) intendeth to a Sperical form, and with its globoſitie or riſing, overpaſſeth moſt high Mountains. But hear again will ariſe another doubt to the inexpert. That is, If the Sea be higher than the Land, how is it then that it doth not drown and cover the Earth, whereunto I anſwer, that the drineſs of the Earth may ſo long reſiſt the moiſtneſs of the Water, untill it receive or imbibe too much moiſtneſs, which may thus be naturally proved. Fill a Cup, a Glaſs, or other Veſſel with Water or Wine to the brim, ſo that the fulneſs thereof may ſeem to ſwell as if it would overflow the brim of the Cup. Then may you yet put therein many pieces of Gold, without ſhedding one drop of Water. But if the extreamity of the brim be once wet, immediately the Water overfloweth, becauſe the drineſs of the Veſſel doth participate of the moiſtneſs of the Water: which is yet better proved in the manner as followeth: Take a certain quantity of Water and ſprinkle it by drops upon a dry (or duſty) Table: ſo ſhall the drops partly

ſhew

ſhew a Sperical form remaining; but if the Table before be never ſo little wet with Water, the drops ſprinkled thereon, ſhall float abroad, and keep no ſperical or round form, by reaſon of the moiſture that the Table hath received before of the Water. It hath oftentimes happened that certain Towns and Lands have been drowned by the Rivers overflowing near unto them. Nevertheleſs, how much ſoever ſuch Waters increaſe or riſe, there is no danger, untill great Showres falling from Heaven, do thorowly wet the Banks, Ramperts and Calſeys of ſuch Rivers. For when they (as we have ſaid) are thorowly imbibed with moiſtneſs, they cauſe the overflowing and breach, whereof followeth the overflowing and drowning of the Region: And this may ſuffice for Advertiſement. Now I ſhall inſtance the aforeſaid experiment ſhewed at *Toleto* by two *Greeks*: who taking a Chalderon of great Capacity, the Mouth turned downwards, and ſo hanging it in the Air by Ropes, they faſtened certain Boards, Poſts, or Shelves in the middeſt of the Chaldron, where they placed themſelves with the fire. Then to make it hang ſtedfaſtly and equally, they compaſſed the Circumference, brim, or border thereof with Leaden Plummets, every ſide equally, and made of equal weight, leaſt any part of the circumference of the mouth of the Chaldron, except it were equally & ſoftly let down into the water, ſhould ſooner touch the water then the whole circumference. For ſo ſhould the water eaſily overcome the air incloſed in the chaldron, and reſolve it into moiſture. But if by due proportion the Chaldron thus prepared, be fair and ſoftly let down into the water, the air incloſed in the chaldron (by reſiſtance of the water) ſhall violently make it ſelf place, not admitting the water to enter. So the men there incloſed, ſhall ſo long remain dry in the middeſt of the water, untill ſucceſs of time do by reſpiration debilitate and conſume the incloſed Air, turning it into groſs humidity, ingroſſed by the coldneſs and moiſtneſs of the water: but if in due time the chal-

dron be ſoftly and equally drawn out of the water, the men ſhall remain dry and the fire not extinct, as it was then experimented, which alſo may be thus proved: take a Cup or Glaſs of a certain quantity: the circumference of the mouth whereof, ſhall be broader then the circumference of the bottom. In the mouth let be faſtened a little ſtick, tying thereunto a thread: on the ſtick, faſten a little candle of wax, whoſe light may come only to the middeſt of the cup, leaſt as much nearneſs of the water might ſuffocate the candle. Then proportionably (as in the former experiment) put the cup with a burning candle into a Veſſel full of water, and in due time draw it out ſoftly and equally, ſo that no part of the mouth of the circumference thereof be drawn out before the whole, or ſpeedily, ſo ſhall the candle remain in extinct. Let not therefore the Ignorant condemn our writings, before they know what may be done by experience. It is now no miracle, when it is known to be natural: and thus it is in all other Sciences and Experiments, which the common people think to be impoſſible. As that the ſalt water of the Sea may be made freſh, and Potable to be drunk; which nevertheleſs may be done naturally, as hath been often proved divers ways. Some do this (as is written in *Gemma Philoſophica*) putting the ſalt water in a Veſſel plaiſtered or cruſted over with clean wax, which diſtilling through the ſtrait or narrow pores thereof, leaveth the ſalt, which for its groſſneſs cannot paſs thereby. The ſame may be done better by a Canon or Pipe, filled with Gravel or little ſtones, that the ſalt water poured thereon may divers times paſs through that Pipe into another Veſſel.

Furthermore, Let theſe Ignorant People take notice that the Arts and Sciences have all of them in the latter Ages either been revived from decay, or reduced to uſe, or brought forward to perfection: ſo many ſecrets of nature and rare concluſions having been found out by and imparted to the World by *Albertus Magnes*, *Levinus Lemnius*, *Fernelius*, *Fracoſtorius*, *Baptiſta Porta*, *Cornelius*

lius Agrippa, Cardanus, Trithemius, Delrio, and infinite others, beſides our own Countreymen, ſuch Inventions as have been ſingular and artificial, for the uſe, eaſe, delight, or ornament of Mankind, as a number of Mechanical, Mathematical and Muſical Inſtruments, Chimneys, Stirrups, Paper, Spectacles, Purcellan, Perſpective-Glaſſes, Fining of Sugars, Hand-mills, Glones, Hats, Bands, Watches, beſides divers excellent Works in Stuffs and Silks, in Linnens, in Hangings, in Carpets, with many others, particularly ſet down by *Polydor Virgil de Inventoribus rerum,* and *Pancirollus* in his *nuvo reperta,* and *Cardanus* in his 17 Book *de Artibus, artificioſiſque rebus,* to whom notwithſtanding much more might be eaſily added, for as truth is the Daughter of time, ſo are uſeful Inventions too, as rightly *Manilius.*

Sed cum Longa dies acuit mortalia corda
Et Labor ingenium miſeris dedit, & ſua quenq;
Advigilare ſibi juſſit fortuna premendo;
Seducta in varias certarunt pectora curas,
Et quodcunque ſagax tentando reperit uſus,
In commune bonum commentum L. ta tenere.

But when the tract of time had whet mens wits,
And Induſtry had moulded them by fits;
Fortune preſſing each Man to endeavour
To free himſelf from miſery, together
They bend their Minds to ſearch out ſundry things;
And what is found by obſervation ſage,
They chearfully impart from age to age.

I will only ſpecifie ſome other of the rareſt Artificial Works of this latter Age, comparable for Workmanſhip with the beſt of the Ancients,

Peter Ramus tells us of a wooden Eagle, and an Iron Fly, made by *Regiomontanus* a famous Mathematician of *Norimburgh,* whereof the firſt in Imitation of *Architas* his Dove, met the Emperor a good way off coming towards it, and having ſaluted him returned again, waiting on him to the City Gates. The ſecond at a Feaſt whereto he had invited his loving Friends, flew

forth of his hand, and taking a round, returned thither again, to the great Astonishment of the Beholders; both which the Divine Pen of the Noble *Du Bartas* hath excellently expressed.

Why should I not that wooden Eagle mention,
A Learned *Germans* late admired Invention,
Which mounting from his fist, that framed her;
Flew far to meet an *Almain* Emperour:
And having met him, with her Noble Train
And weary Wings, turning about again,
Followed him close unto the Castle-gate
Of *Norimburgh*, whom all their shews of State,
Streets hang'd with Arms, Arches curious built;
Grey-headed Senate, and Youths, gallantise,
Graced not so much as only this device.

He goes on, and thus describes the Fly.

Once as this Artist, more with Mirth than Meat
Feasted some Friends whom he esteemed great;
From under's hand an Iron Flie flew out;
Which having flown a perfect round about,
With wearied Wings return'd unto her Master,
And as judicious on his Arm he plac'd her.
O Divine Wit! that in the narrow Womb
Of a small Fly, couldst find sufficient room
For all those Springs, Wheels, counterpoise and Chains,
Which stood instead of Life, and Spur, and Rheins.

Desimanus itaque Architas columbam mirari, cum muscam, cum aquilam Geometricis alis alatum Norsbergea exhibeat, saith *Ramus*, let us give over to wonder at *Architus* his Dove, hitherto *Norimburgh* hath exhibited both a Fly and an Eagle winged with Geometrical Wings. *Bartas* likewise remembers the curious Dial and Clock at *Stransburgh*, my self have beheld not without Admiration.

But who would think that mortal hands could mould,
New Heavens, new Stars whose whirling courses should
With constant windings, through contrary ways.
Mark, the true monds of years, and months and days,

Yet

Yet 'tis a ſtory that hath oft been heard,
And by a hundred witneſſes averr'd.

Neither doth he forget the moſt excellent Silver Sphere (matchable with *Archimedes*, or that of the *Zapores* King of *Perſia*) which was ſent as a preſent by the Emperour *Ferdinand* to *Solyman* the Great *Turk*; and is mentioned by *Paulus Jovius* and *Sabellicus*; it was carried as they write by twelve men, unframed and reframed in the *Grand-Seignors* Preſence, by the maker, who likewiſe delivered him a Book containing the Myſtery of uſing it.

Nor may we ſmoother, or forget ingrately
The Heaven of Silver, that was ſent but lately
From *Ferdinando*, as a famous Work
Unto *Byzantium* to the greateſt *Turk*:
Wherein a Spirit ſtill moving to and fro,
Made all the Engine orderly to go:
And tho' the one Sphere did always ſlowly ſlide,
and contrary the other ſwiftly glide;
Yet ſtill their Stars kept all their courſes even
With the true courſes of the Stars of Heaven.
The Sun there ſhifting in the Zodiack
His ſhining houſes, never did forſake
His pointed Path, there in a Month his Sifter
Fulfil'd her courſe, and changing of't her Luſtre
And form of Face (now larger, leſſer ſoon)
Followed the changes of the other Moon.

So that which way ſoever we turn our Eyes, we may ſee that Poſterity hath not riotouſly waſted the Inheritance of Arts and Sciences, left them by their Predeceſſors, but have greatly increaſed the ſame and invented others: for certainly the multitude of things incomprehenſible, is infinite, and ſo therefore inventions muſt needs alſo be infinite, and without end, like tunes in the Art of Muſick.

And foraſmuch as I have made mention of ſundry Inventions, it ſhall not be from the purpoſe, to deſcribe the goodly Inſtrument whereof *Angelus Politianus* in his

his fourth Book of Epiſtles to *Franciſcus Caſo*, where he writeth in this manner, I have received your Epiſtle, wherein you ſignify to me, that you have heard of the ſtrange Engine or Inſtrument *Antomatan* invented, and made of late by one *Lawrence* a *Florentine*; in the which is expreſſed the courſe and motions of the Planets conformable and agreeable with the motions of Heaven, and foraſmuch (*ſaith he*) as the report thereof is hardly believed, you greatly deſire that I ſhould write to you, what certain Knowledge I have of that thing, wherein I am ready to obey your Requeſt. And altho' now it be long ſince I ſaw it, yet as far as I bear in memory, I will briefly expreſs to you the Form, Reaſon, and Uſe thereof. And if the Deſcription thereof ſhall ſeem to you to be ſomewhat obſcure, you ſhall not aſcribe it altogether to my Declaration, but partly to the ſubtlety and Novelty of the thing. It is in form of a ſquare Pillar, ſharp towards the top, in the manner of a *Pyramidis*, of height almoſt three Cubits: over and above it in manner of a baner, is a flat or plain round of guilded Copper, adorned with ſundry Colours, on whoſe other part is expreſſed the whole courſe of the Planets, and whoſe Dimenſion or Meaſure is ſomewhat ſhorter then a Cubit, and is within turned and moved with certain little Denticle Wheels, an immoveable Circle comprehending the higheſt Border or Margent, divided with the ſpaces of 24 hours within it, in the higheſt turning Roundel, the twelve ſigns are diſcerned by three Degrees. Further, within are ſeen eight Rundels, in manner of one greatneſs, of theſe two obtain the middle point, the one faſtened in the other, ſo that the loweſt being ſomewhat bigger, repreſenteth the Sun, and the higher the Moon. From the Sun a beam coming to the circle, ſheweth in it the hours: and in the Zodiack, the Months, days, and number of Degrees, and alſo the true and half Motion of the Sun. From the Moon alſo proceedeth a Pin, or Ryer, which beneath or downward in the Border or

Margent

Margent of the greateſt Rundel, ſheweth the hours: and paſſing by the Center of the Epicide of the Moon, and extending to the Zodiack, ſheweth the half Motion of his Planet. Another alſo riſing from thence, and cutting the border of the Center of the Moon (that is of the Epicide) ſheweth her true place, whereby are ſeen the ſlowneſs, ſwiftneſs, all Motions and Courſes, Conjunctions alſo and full Moons. About theſe are ſix other Rundels, of the which, one whom they call the Head and Tail of the Dragon, ſheweth the Ecclipſes both of the Sun and the Moon. The other are attributed to the Planets; from every one of which, proceed two points, aſſigning the Motions (as we have ſaid) of the Moon, but they alſo go backward, which chanceth not in the Moon, whoſe Ecclipſe is moved contrariwiſe. And thus the reaſon of Conjunctions, Departings, and Latitudes is manifeſt in all. There is alſo another Border likewiſe to the Zodiack, cutting or dividing upward or above, thoſe ſix little Rundels of the Planets, whereby appeareth the Degrees of the Eaſt ſigns, and the ſpaces of the days (that is to ſay) at what hour the Sun riſeth, by the which, every one of the Planets are carried in their Rundels or Circles by courſe, in the daytime to the Eaſt, and in the Night to the Weſt. Again contrariwiſe, the greateſt Rundel of all, draweth with it allthe Planets, in the Night to the Eaſt, and in the day to the Weſt, in the ſpace of 24 hours. All which to agree with the Motions of the Heavens, both Reaſon and Experience do confirm; and therefore we ought not to marvel if theſe things ſeem incredible to many. (For as ſaith the wiſe Proverb) Faith is ſlowly given to great things, for even we ſcarcely believe our own Eyes, when we ſee ſuch things. And therefore, whereas in time paſt I read, that ſuch a like Inſtrument was made by *Archimedes*, my Faith yet failed to give Credit to ſo great an Author, which thing nevertheleſs this our *Florentine* hath performed. The work doubtleſs being of ſuch an Excellence, that all praiſe is inferiour

riour to it, and cannot otherwiſe for the worthineſs thereof, be otherwiſe praiſed, then to ſay that it is above all praiſe; inſomuch that he may ſeem a man ſent from Heaven, where he learnt the making of this Heaven; Hitherto *Politianus*. Of the like Inſtrument, *Roger Bacon* maketh mention, affirming the ſame to be worth a Kingdom to a wiſe man. But foraſmuch as the Subject I have diſcourſed of is chiefly touching Inventions appertaining to Ships, and the Art of Navigation, I ſhall here think it fit to ſay ſomething of the Invention of a certain *Italian* Writer *Leonardo Fioravanti*, who in his Book Intituled, *Specchio di Sciantia Univerſale*, doth greatly glory in the Invention of Ships, which cannot periſh either on the Sea, or the Land, affirming the like was neuer invented ſince the Creation of the World. But I fear, leaſt his vain Glory of diſcourſing in the *Italian* Tongue, hath cauſed him more then needs, to commend his own invention. Therefore commiting the judgment hereof to men of greater Experience and Knowledge in theſe things, I will only tranſlate his Words, whereby in the book before-named, he deſcribeth the ſame Ship in this manner. Take Beams of Fur or Pine-tree, which of their own nature can never ſink or go down, or remain under the Water, and with theſe Beams frame an Engine or Machine, of the length of threeſcore foot, and of the height of ſix foot, and of the breadth of twenty foot, laying the firſt rank in length, faſhioning the fore-part like unto other Ships, and in like manner, bringing the poop or hinder part to good Form; then with ſuch Irons as appertain bind it, and ſtrengthen it in ſuch manner as it cannot break. And upon this Frame or Foundation build your Ship, of ſuch faſhion as you think beſt, &c. But whether the Frame or Foundation ſhould be builded upon the Keel or bottom of the Ship, or otherwiſe (as I have ſaid) I muſt commit it to them of better judgment. But leaſt I ſhould be unmindful of my Promiſe, concerning the rare Geometrician *Beſon*, that cauſed a book to be Printed containing

taining the Forms and Portracts of 60 Engines of marvellous ſtrange and profitable Device, of which I only mentioned three foraſmuch as they chiefly appertain to Ships, *viz.* the 54, 57, 60. I ſhall here make a brief Reherſal of them, the 54 therefore (as he writeth) is an Engine not unlike to that which *Archimedes* in former time invented for the *Syracuſians*, wherewith a man with the ſtrength of only one hand, by help of the Inſtrument called *Triſpaſton* (which in our Tongue ſome call an endleſs ſcrue) brought a Ship of marvellous greatneſs from the Land into the the Sea, in the ſight of King *Hieron*, and an infinite Multitude which with all their force could not do the ſame, *&c.* Of which alſo our Countrey-man *Roger Bacon*, a great Philoſopher ſeemed to have had ſome Knowledge: he making mention of an Inſtrument no bigger then a mans body, wherewith one man might draw to him the ſtrength of three hundred men. And when I was in *France* I heard credibly reported that an *Almain* made an Engine, where with one at 15 years of Age lifted from the ground a weight, which the ſtrongeſt man in the Court was not able to remove. Almoſt the ſame device we ſee in the bending of a Croſs-bow. Alſo at my being in *Germany* in the City of *Straſburgh*, a worthy Gentleman, *Monſieur de Saleno*, told me that in that City one had invented an Engine of Iron, no bigger than a mans hand, whereunto faſtening a Rope, with a hook of Iron, no bigger than a mans head, and caſting the hook upon a Wall, Tree, or other place, where it might take hold, he could with that Eugine liſt himſelf up to the Wall, or other places. But to return to the other two Engines of *Beſon*, pertaining to our purpoſe, The 60 Figure (as he there writeth) is the Invention of an Engine, ſcarcely credible, wherewith by Ballance and eaſie Motion, beyond the order of Nature, a Ship ma be ordered and governed, that in the calm Sea it ſhall move forwards, and in little Wind haſten the courſe, and in too much Wind, temper and moderate the ſame; a Secret (as he

ſaith)

ſaith) worth the Knowledge of a Prince. Of the third Engine which is the 57 of his Book, he writeth thus, an Artifice not yet divulged or ſet forth, which placed in the poop of a Ship, whither the Water hath Recourſe, and moved by the Motion of the ſhip with Wheels and Weights, doth exactly ſhew what ſpace the Ship hath gone, *&c.* by which Deſcription, ſome do underſtand that the Knowledge of the Longitude might ſo be found a thing doubtleſs greatly to be deſired, and hitherto not certainly known, altho' *Sebaſtian Cabot* on his Death-bed, told me he had the Knowledge of the ſame by Divine Revelation, yet ſo, that he might not teach any Man. But I think that the good old man, in his extream Age, ſomewhat doted, and had not yet even in the Article of Death, utterly ſhaken off all worldly vain Glory. As touching which Knowledge of the Longitude, to ſpeak a little more by occaſion now given, it ſhall not be from the purpoſe, for to rehearſe the Words of that Excellent Learned man, *Joannes Fernelius*, in his incomparable Book *de abditis rerum cauſis*, where in his Preface to King *Henry* of *France*, he writeth thus, we have put our helping hand to the Art of Navigation and Geography; for by the Obſervation of the hours of the Equinoctials, we have invented how in whatſoever Region or place of the World a man ſhall be, he may know in what Longitude it is; which certainly we have not taken from the Fountains of the Ancients, but firſt of all (as I think) have drawn it out of our own Rivers, as our own Invention. I ſhall conclude (as I ſaid before) that which way ſoever we turn our Eyes, we may ſee that Poſterity hath not riotouſly waſted the Inheritance of Arts and Sciences, left them by their Predeceſſors, but have greatly improved and increaſe the ſame, and alſo invented others.

FINIS.

pp. 129 – 132 on
Magnet and
Mariner's Compass